48120

Detailing Scale Canopies—pg. 28

MODEL AIRPLANE NEWS

THE WORLD'S PREMIER R/C MODELING MAGAZINE

July 1994

exclusive ENGINE GUIDE 32

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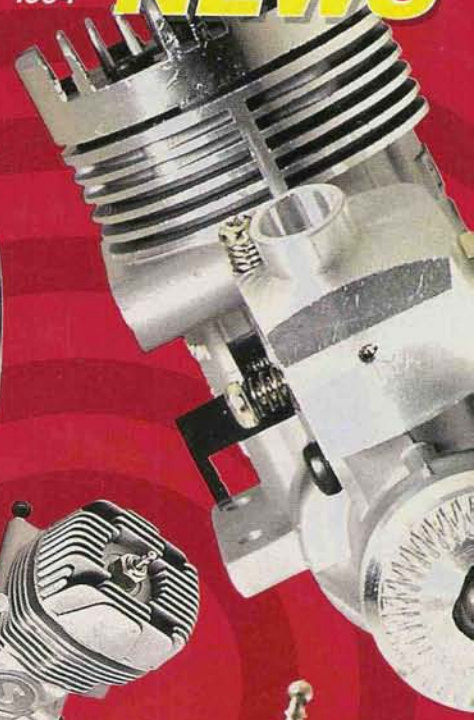

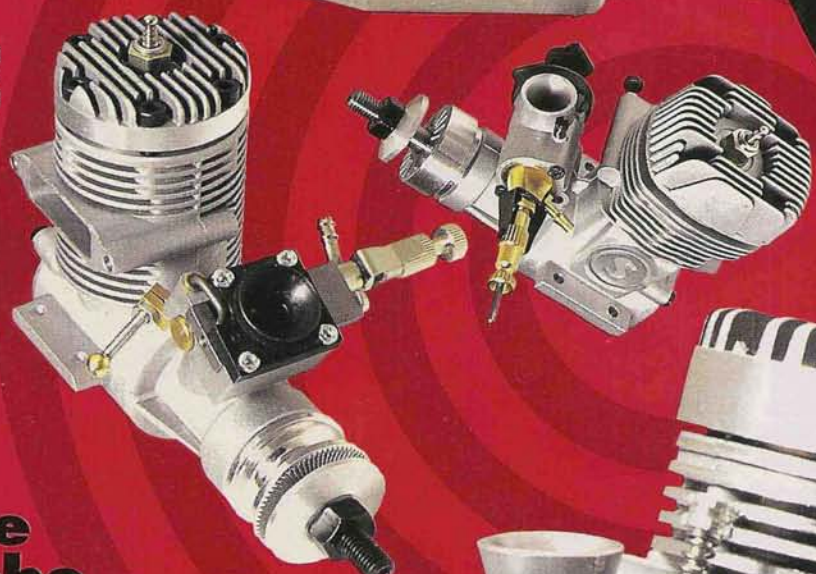

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JULY 1994 VOLUME 122, NUMBER 7

MODEL AIRPLANE NEWS

FEATURES

ABOVE: *Bob Fiorenze checks the engines on his Yellow Aircraft F-14 Tomcat at the International Jets Over Deland ducted-fan meet.*

ON THE COVER: *five of the 32 2-stroke .40 engines surveyed in this issue's Engine Guide are shown. Top, left to right—MECOA Zeus, Enya Super Sport; middle, left to right—Webra Quickee 500, SuperTigre GS Ring; bottom—Fox BB Deluxe.*

FEATURES

CONSTRUCTION

COLUMNS

COLUMNS

DEPARTMENTS

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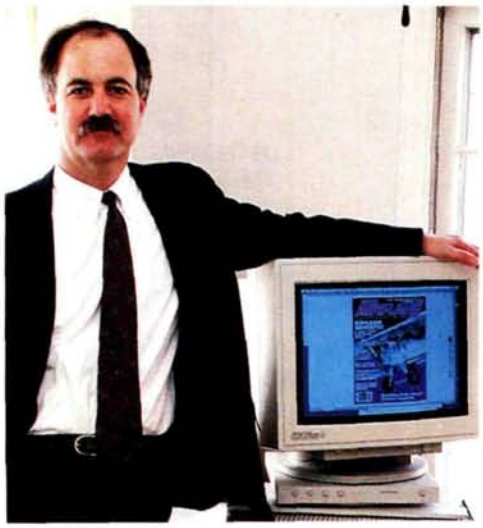
PUBLISHER'S PAGE

TOM ATWOOD NAMED GROUP EDITOR-IN-CHIEF



As a reader of *Model Airplane News*, you are no doubt familiar with the name of Tom Atwood—since 1990, this magazine's editor-in-chief. Tom is the man who so carefully molds *Model Airplane News* into a publication that fulfills many roles: at once serving as an information source—a helpful hand to aeromodelers—and an enthusiastic, supportive voice in our hobby.

Tom's tenure with *Model Airplane News* has been marked by success: in attracting high-caliber contributors and carefully fashioning the magazine to meet the needs of you, the reader, Tom has helped this magazine become the most widely read and respected R/C aeromodeling publication, with a paid readership of 90,842 (six months ended December 31, 1993, as filed with the Audit Bureau of Circulations, subject to audit).

I'm pleased to announce Tom's promotion to Group Editor-in-Chief for all Air Age publications. For readers, advertisers and friends of all our magazines—*Model Airplane News, Radio Control Car Action* and *Radio Control Boat Modeler*—that's good news. Why? Because it means that Tom's editorial expertise, his boundless enthusiasm for all things R/C and his unique ability to communicate effectively with hobbyists, will touch not only the readers of this magazine, but also tens of thousands of other R/C enthusiasts, too.

At Air Age, we pride ourselves on our efforts to serve our audience and to help the radio-control hobby grow and flourish. And that's why we take so much pride in all our employees—men and women who, like Tom, are dedicated to producing the very finest, most useful R/C magazines available. In short, we're all here to help *you* enjoy your hobby.

Louis DeFrancesco Jr.
Group Publisher

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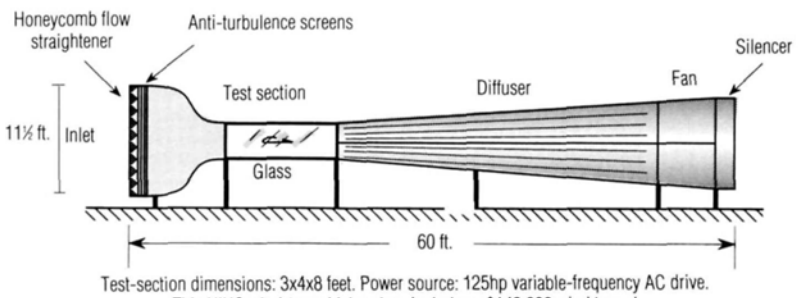
EDITORIAL

TOM ATWOOD

HELP ADVANCE THE ART

Rarely do grassroots modelers have a chance to help advance the science of aeromodeling, but such an opportunity now exists, and the cause is a worthy one—the design of airfoils for glow and gas-powered models. Major strides have been made in the development of airfoils for sailplanes, but what about airfoils for glow and gas ships? Whether or not you give a hoot about aerodynamics, superior airfoils do allow models to fly better. Are you in favor of kit manufacturers having access to airfoils that improve aerobatics, racing, soaring, fun-fly competition and hot-dogging performance? Would you like publications and software that contain proven airfoils for these applications to be made available? All of this can and will happen if only a tiny percentage of our readers help out.

UIUC OPEN-CIRCUIT LOW-SPEED WIND TUNNEL.



Test-section dimensions: 3x4x8 feet. Power source: 125hp variable-frequency AC drive. This UIUC wind-tunnel laboratory includes a $140,000 wind tunnel

To develop such airfoil data, you need special elements such as a wind tunnel and related equipment, computers, sample airfoils to test and science wizards with the time and interest to make the observations and oversee the number crunching. Such an assemblage came together a few years ago when Selig, Donovan and Fraser completed "Airfoils at Low Speeds" (sometimes referred to as the "Princeton wind-tunnel tests"), which is published in the eighth volume of Herk Stokely's SoarTech series. "SoarTech 8" is 395 pages long and contains wind-tunnel data on nearly 60 airfoils. These airfoils are primarily for sailplanes. The results of that landmark study have greatly influenced the choice of airfoils by competitors and kit manufacturers. If you are interested in SoarTech 8, send an SASE to Herk Stokely, Editor, SoarTech, 1504 Horseshoe Cir., Virginia Beach, VA 23451.

The airfoils described in that book are now available in software such as the IBM-compatible "Airfoil Plot Program" ($35; Chuck Andersen, P.O. Box 305, Tullahoma, TN 37388; 615-455-6430), CompuFoil Plus ($45; CompuFoil Professional, 3904 Traine Dr., Kettering, OH 45429; 513-299-7684) and the late David Fraser's Version 3.4 sailplane design performance program ($35; 360K IBM; available from SoarTech). USR&D Corp. also plans to use airfoils from SoarTech 8, and from further investigations by Michael Selig, in future versions of AERO*COMP software (performance characterization for electrics). USR&D can be reached at 908-850-4131. For Mac users, there's MaxSoar, which has all the SoarTech airfoil data in a fine sailplane-analysis program (Imagesoft, John and Linda Hohensee, S. 22 W. 27400 Fenway Dr., S. Waukesha, WI 53188; 414-521-2472).

NEW TESTING PROGRAM

Michael Selig was one of the graduate students who produced "Airfoils at Low Speeds," and he is now a professor at the University of Illinois at Urbana—Champaign. With the help of colleagues and one of his graduate students, he is again testing airfoils. This time, the scope is not limited to sailplane airfoils, and this spells opportunity for the large community of powered-aircraft modelers. In a recent open letter that was widely distributed in the industry and published on the Internet, Michael notes:

"There is a need for new airfoils for R/C sport, aerobatic and electric planes, as well as R/C helicopters. Often, old NACA/NASA airfoils are used for these aircraft. Compared with airfoils that could be designed today, these NACA/NASA airfoils (which were designed decades ago, mostly by trial and error) are inferior. At the time the NACA/NASA airfoils were designed, little was known about the complex aerodynamics of airfoils operating at low Reynolds numbers. (Airfoils with small chords at low speeds, such as those on model aircraft, are said to operate in the low-Reynolds-number flight regime.)"

If there's enough support from the modeling community, Michael also intends to explore the effects of flaps, turbulators, trips, airfoil-contour accuracy and airfoil blending from root to tip.

This chance may be as transient as it is rare. When again will we have a university setting with wind tunnels, etc., where real ground can be gained in model airfoil design? Twenty years from now? Fifty years? This situation just doesn't arise in the normal course of events, and we have to strike while the iron is hot.

Consider that the wind tunnel now available for tests cost a mere $140,000, and that another $125,000 of instrumentation sits in it or next to it. The going rate to use this equipment is $7,000 a week. Because Michael has a graduate student, Jim Guglielmo, working on a thesis that requires the testing of model-size airfoils, access to this equipment is available for no more than Jim's stipend! Michael needs $2,500 to keep Jim on the project until the end of this year. This is the absolute minimum required. If Michael had more money, he could hire a second research assistant. To keep the project going with two research assistants through the summer of 1995, he needs about $12,000 (that's the $2,500 already mentioned, plus $9,500 more). They would test approximately 60 airfoils over this 12-month period. *That works out to*

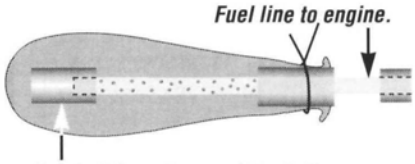
(Continued on page 134)

AIRWAVES

WRITE TO US! We welcome your comments and suggestions. Letters should be addressed to "Airwaves," **Model Airplane News,** 251 Danbury Road, Wilton, CT 06897. Letters may be edited for clarity and brevity. We regret that, owing to the tremendous numbers of letters we receive, we cannot respond to every one.

ERRATA

- On page 90 of our May '94 issue ("Sporty Scale Techniques"), the caption in the lower left corner notes that Andy Bartosh built a 1/3-scale model of a racing biplane commissioned by John Deere in '33 from Laird Turner. Andy, who builds models under contract, indicates that the noted incorrect incidence measurement in the upper wing was inadvertently copied from the plans in the building process and wasn't introduced by him.
- The test results on page 62 of Tom Hunt's article on the Aura 2 and Aveox 1412/7 motor in our April '94 issue showed transposed rpm figures for the Master Airscrew 12x8 folding prop. With this prop, the motor produced 6,100rpm on 12 cells and 6,400rpm on 14 cells.



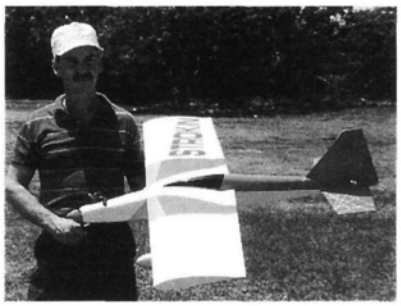
Soft fuel line at rear of the balloon prevents accidental puncture.

BALLOON FUEL-TANK UPDATE

Regarding Nick Ziroli Sr.'s article on the balloon tank in the April '94 issue: this is basically the same tank system I've been using on my competition fun-fly airplanes, including my WidowMaker, which won the 1993 Technical Achievement Award at the Fun-Fly Nats. When I started using the plumbing system that's shown in the article, I immediately ran into some problems. The tank might be great for a small airplane, but in my experience using it in fun-fly airplanes, the fuel was moved around violently. As the fuel was consumed and the balloon collapsed, the pick-up tubing was shut off, and no fuel could get to the engine. A simple fix was to pierce the entire length of the tubing that's inside the balloon. To prevent the tubing from puncturing the balloon (a rarity, but it can happen), I also attached a small length of soft silicone fuel line to the tip of the tubing. With this system, the fuel will be picked up no matter where the fuel is inside the balloon.

AZARR
New Carlisle, OH

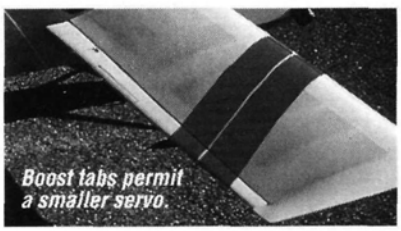
Thanks for the tip, Azarr. Readers experimenting with this system will benefit from your R&D. TA



AERODYNAMIC BOOST TABS

In the May '94 "Airwaves," you asked for responses from modelers who are using aerodynamic boost tabs. I've enclosed photos of my original design, "Strokin." One is a 40-size model powered by an Enya 53 4-stroke. It's a terrific flier. It has a 52-inch wingspan, weighs 4 pounds and is finished entirely with iron-on MonoKote. The 40 flew so well that I decided to blow it up to an IMAA-legal aircraft. "Strokin 120" has an 83-inch wingspan, weighs 11 pounds and is also finished with iron-on MonoKote. I built molds, vacuum-formed the canopy and wheel pants and made the control horns and landing gear out of 6061 sheet aluminum. The aircraft is powered by an O.S. 108 with a tuned pipe swinging a 15x6-10 prop, and it has unlimited vertical.

Carl Risteen's articles on aero-



dynamic boost tabs, "Labor Saving Devices for Overworked Servos" in the September and October '93 issues were published while the model was under construction, and I decided that boost tabs would alleviate the need for heavy, ¼-scale servos.

I sized and installed the boost tabs exactly as specified in the article. After two flights, I had to reduce movement of the elevator tabs as the plane was *too* sensitive in the pitch mode. Since I made this minor adjustment, the aircraft flies like a 40-size model and uses the same standard servos.

Having read Dave Patrick's article, "Smoke 'Em with 2-Strokes!" (May '94 issue), I'm now adding a smoke system. I wish the article had discussed using tuned pipes. Thank you for your great articles. *Model Airplane News* is the most informative R/C plane publication on the market.

GARY SWANEY
VP Sparks, St. Petersburg, FL

Thanks for the photos, Gary. We're impressed by your design and delighted that you benefited from Carl Risteen's and Dave Patrick's recent articles. I'll ask Dave to comment on tuned pipes and smoke in a future column. Is anyone else out there using aerodynamic boost tabs? We think fun-fly and hot-dogging airplanes are perfect candidates for this technology. TA

SCHWEIZER COWL, PLEASE

Help! I have an old set of plans (no. FSP11811) for a Schweizer I-30. The address on the plans for Fiberglass Master, a company that makes a fiberglass cowl for the model, isn't current. Can you give me their new address?

BOBBY SMITH
Goldsboro, NC

Bobby, the address for Fiberglass Master is Rte. 1, Box 530, Goodview, VA 24095; (703) 890-6017. Ask for Myron Pickard, and tell him we sent you. GY

(Continued on page 118)

PART 2

Further refinements for improved biplane performance

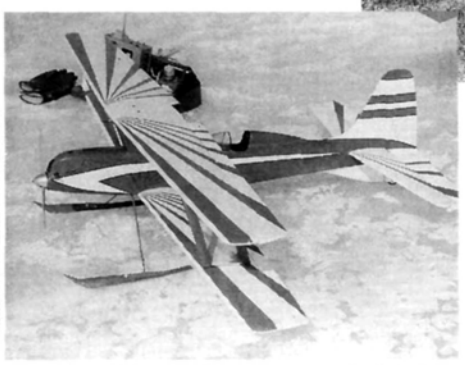
Biplane Secrets

by CARL RISTEEN

PART 1 OF this article briefly covered the evolution of airplanes, and how it led to biplanes, with their problem of mutual wing interference, and methods to combat it. Also covered were the effects of stagger, decalage, wing flaps and incidence. This part covers further refinements that have been shown to improve biplane performance. In Part 3, in the next issue, I'll look at triplanes and some angles on bipe fun-fly designs and more on interplane strut design.

Although long-time favorites of scale modelers, bipes have not, except for a few outstanding models, fared all that well against monoplanes in purely performance-oriented model competition. This is because of their inherent aerodynamic shortcomings. Many of these shortcomings can be offset by cunning design and construction, thereby permitting the bipe's unique, inherent strengths to shine through.

A 68-inch-span biplane designed by the author for .60 to .73 2-stroke power, shown here with a Webra .73 and quiet muffler. Doreen Armstrong holds the plane.*



PHOTOS BY CARL RISTEEN AND SCALE MODEL RESEARCH

A later modification of the same bipe included the addition of streamlined skis. Bipes are great on skis.

TAPERED WINGS: UNUSUAL BUT PERFORMANCE ENHANCING

At just about the apex of biplane development, some outstanding tapered-wing designs appeared. Two paramount examples were the deHavilland DH 86 Express and DH 89 Dragon Rapide of 1934. Four- and two-engine airliners, respectively, these were arguably the most gorgeous multi-engine bipes ever built. Both featured relatively high-aspect-ratio wings with a graceful and efficient semielliptical taper. The smaller DH 89 has also been considered almost as important as the DC-3 in advancing air travel. A total of 1260 DH 89s, including the military version, the Dominie, were built. Many remained in service for decades. Their excellent handling, reliability and short-field capability were particularly valuable in extending airline service to smaller communities serviced by crude, short airstrips. Al Williams' beautiful racing Gulf Hawk of the 1930s was another example of a superb tapered-wing bipe.

Tapered wings are something of a rarity on full-scale bipes. On an unbraced monoplane wing, taper can save a lot of weight. Taper makes the wing thicker near the fuselage, where bending moment is highest. This provides room for deeper spars that are much stronger for their weight. Taper also moves the center of aerodynamic loading closer to the fuselage, reducing the bending moment and further lightening the structure. Tapered wings require less aileron-control effort to produce a given roll rate, and they produce less aileron-induced yaw. In addition, both profile and induced drag are reduced, and lift is increased by a few percent. This combination of weight saving and increased efficiency can mean the difference between a so-so airplane and an outstanding one.

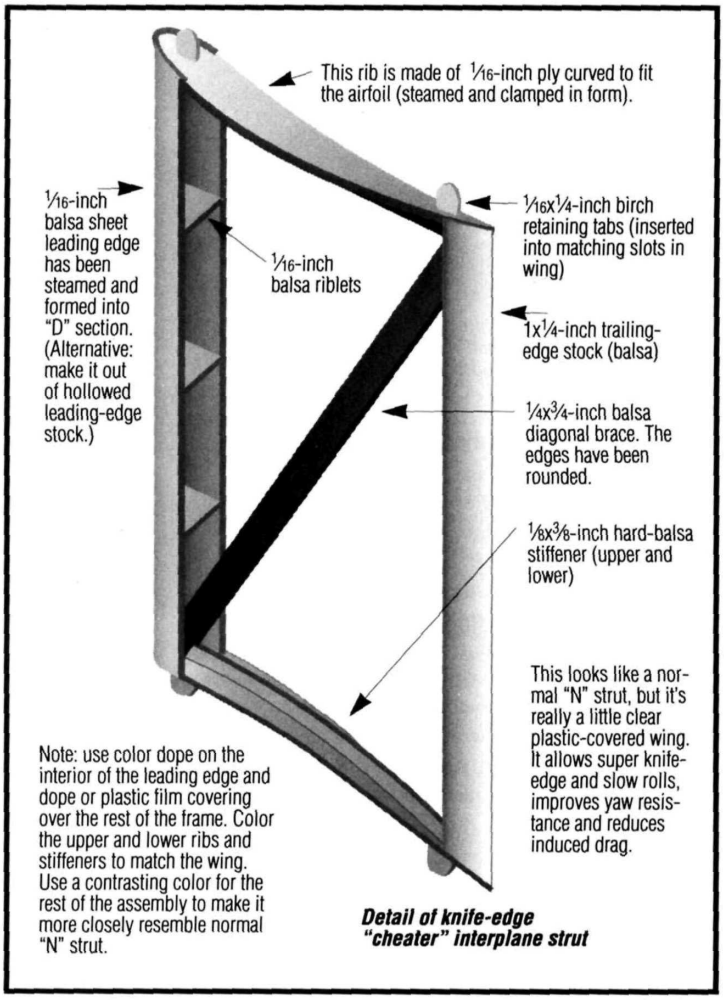
In most full-scale bipes, wire bracing carries the lion's share of the wing bending moment. This negates much of the incentive to create a costly tapered-wing structure, although taper would permit the use of thinner, and thus less "draggy," bracing wires. I switched to tapered wings on my model bipe designs and was pleased to obtain much more axial rolls, a higher roll rate with smaller servos and nicer all-around handling—not to mention a considerable weight reduction.

Tip-stall, a misdeed that tapered wings are frequently accused of, has never been a problem for me. If anything, I think that the reduced yawing couple produced by a small chord tip near stall may make inadvertent stall followed by a snap roll less likely. I should mention that all my bipes have full-span ailerons; shorter, barn-door ailerons would probably tend to produce a little more tip-stall misbehavior. I do use a degree or two of washout (twisting of the wings

achieve a lower incidence angle at the tips) to help keep the ailerons in business right up to deep stall.

The tips of moderately tapered wings, because of their smaller chord, *do* fly at a lower Reynolds number than the wider-chord inboard portions. They also fly in reduced downwash, slightly raising their effective angle of attack. The net result can be a tip-stall at an angle of attack that is half a degree or so lower than with a constant-chord wing, assuming that the airfoil section is constant along the entire span. I like to use a constant leading-edge radius all along the wing (it makes building easier), resulting in a tip section with a proportionally larger leading-edge radius. This kink may help to increase the stall angle of attack by half a degree or so at the tip.

I also like to use box-section main spars with close to ideal taper, with small turbulator spars in place of the more usual D-tube fully sheeted leading edge. This construction results in very light, strong, easy-to-repair wings that, on a monoplane, would probably have marginal torsional stiffness. They work well on a biplane, where the interplane struts provide a lot of additional torsional stiffening. Saving weight is one way to make the biplane layout work for you.

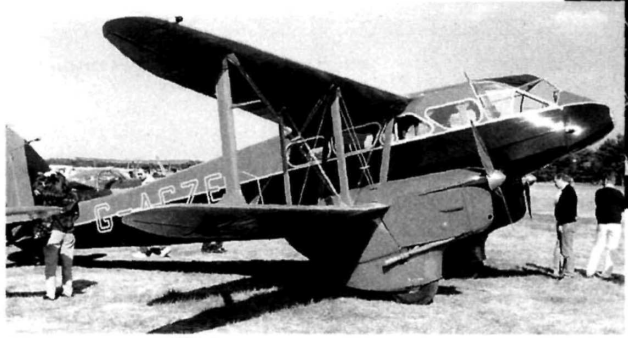


Detail of knife-edge "cheater" interplane strut

AILERONS: TWO OR FOUR?

My first bipe design had two, wide-chord, full-span ailerons on the lower wing and no ailerons on the upper wing. That didn't do the job. In desperation, I increased the aileron travel to nearly 45 degrees each way, but the roll rate, though fine for scale-like, gentle sport flying, was still too slow for snappy aerobatics. Full aileron deflection produced excessive, sloppy yawing and very noticeable drag. The model practically screamed for four ailerons.

You might think that two double-width ailerons would do the job of four narrower ones. They don't. Lowering an aileron on the lower wing of a bipe lowers the pressure, not only on the upper side of the lower wing, but also on much of the underside of the upper wing spanned by the aileron. This lowered pressure tends to pull the upper wing down and oppose the roll. The no-aileron wing also strongly resists being rolled. Rolling induces a change in effective angle of attack that results in a large lift force that opposes the roll. The result is something like trying to steer a car by only one front wheel, with the other wheel locked straight ahead.


The deHavilland DH 89 Dragon Rapide. (Photo courtesy of Scale Model Research.)

Al Williams' racing Gulf Hawk of the late '30s. (Photo courtesy of Scale Model Research).

As an experiment, rather than performing major surgery, I slipped a bunch of thin mini-hinges into the existing trailing edge of the upper wing, and I attached airfoil-sectioned ailerons. The model was transformed, and all of my bipes now sport four ailerons. Another bonus: four ailerons demand less than half as much servo effort to produce a given roll rate, reducing servo and battery weight.

Very small bipes may roll acceptably with only two ailerons, but anything with a wingspan of more than about 48 inches will probably need four ailerons to get anything like an aerobatic roll rate without excessive yaw and drag.

Using a little more travel on the lower wing's ailerons seems to help to keep the center of drag closer to the thrust line and produce rolls that are more axial. A little aileron differential travel (more up than down) will do pretty much the same job.

Bipes with upper and lower wings of unequal size with a lot of aileron area on the larger wing have less need for four ailerons. Roll resistance of the no-aileron wing decreases very rapidly as its dimensions shrink.

If one wing has a shorter span, for best efficiency, its chord should be proportionally reduced by at least as much as its span.

DIHEDRAL

On my aerobatic designs, I like to use a little dihedral—something like 1½ degrees on the lower wing and a nearly equal amount of anhedral on the upper wing. This should give a net result of almost zero overall dihedral effect and remove virtually all the yaw/roll coupling, (the tendency for rudder deflection to cause unwanted roll). Building both wings with zero dihedral would probably have the same effect, but it would tend to give the lower wing an unusual, sagged appearance. I think the dihedral/anhedral combination looks better and, as a bonus, it gives the lower wingtips a little more ground clearance. I also use sheet nylon skids under the tips of the lower wing for additional insurance against asphalt rash.

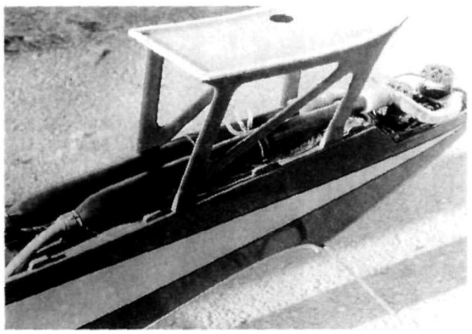
An 84-inch-span bipe with a piped HP120 engine. Another of the author's designs, this 12-pounder has 1,750 square inches of wing area.

BRACING WIRES: FUNCTIONAL OR JUST PRETTY?

Few modelers go to the trouble of equipping their bipes with bracing wires unless they are required for scale fidelity. Contrary to legend, bipe wings make poor birdcages. Fitting a bipe with the wires and all the paraphernalia they entail is very time-consuming, and the work does not stop when the model has been completed. Unless your vehicle can accommodate a fully assembled model, you can spend a lot of time at the flying field, fussing with the wires and fittings when you could be flying.

Having studied the effect of bracing wires on the weight of non-scale bipes with thick, symmetrical wing sections, I have concluded that little, if any, weight can be saved by using wires instead of incorporating an ideally tapered box-section spar. However, to avoid showering the flying field with assorted airplane pieces, scale models of thin-wing WW I bipes probably need wire bracing, or a lot of wing beef.

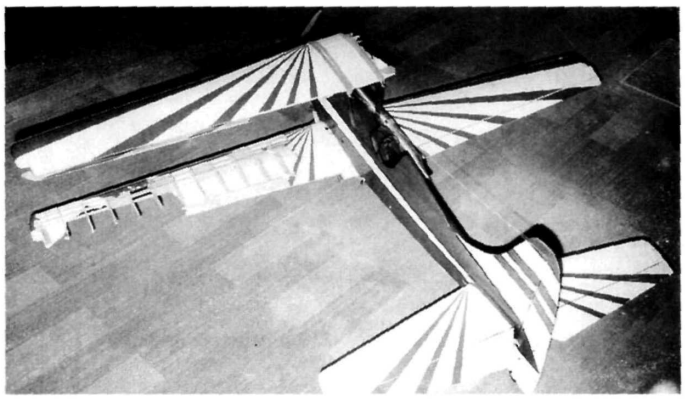
The drag of circular-section stranded-steel cable is very significant. At full speed, the drag of the wires and fittings may equal that of the wings. The necessary attachments for the wires are also difficult to build into the wing structure while minimizing weight. Streamlined solid wires can reduce the drag penalty by up to about 85 percent. *[Editor's note: Aero Scale miniature flying wires—high-quality, streamlined, model-size bracing wires— are available in five sizes from the Nelson Aircraft Co., 21550 N.W. Nicholas Ct., Unit D, Hillsboro, OR 97124; (800) 552-8065.]*



A close-up of the 84-inch sport bipe with the fuselage top removed to allow access to the tuned pipes and headers.

OTHER DRAG-PRODUCING THINGS FOUND ON BIPES

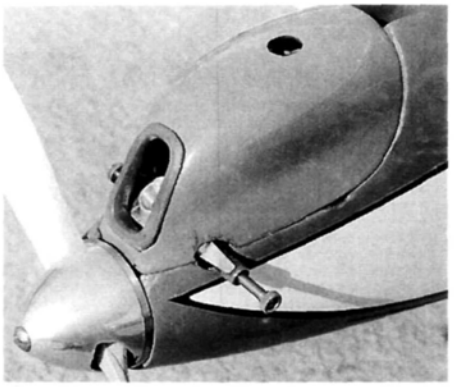
Cabane struts (for attaching the upper wing to the fuselage) made of round wire produce a lot more drag than you might think. Struts made of thin aluminum-alloy sheet or of thin aircraft plywood or hardwood, shaped and sanded to a smooth airfoil section, are far better, drag-wise. Interplane struts (between the two wings) slovenly fabricated of round dowels are sometimes seen on bipe models. These produce tremendous drag. Everything exposed to the air stream should be given a smooth, streamlined shape wherever possible. A motley bunch of little refinements have a way of adding up to produce a lot of drag reduction and reward you with a bipe that flies much better.



The wing flutter damage shown here occurred while the plane was flying straight and level at about 105mph. The flutter was second harmonic, caused by excess tip balance weight on long, flexible ailerons. The flutter was cured by adding mass dampers at the 40-percent-span position. The model landed safely with just one functional aileron. All damage occurred within 0.1 second. The additional wing on the bipe saved the model; this is one advantage of a biplane over a monoplane! On another occasion, the same bipe landed safely after losing the entire upper wing, part of the lower wing and half the stab in a midair collision!

UPPER AND LOWER WINGS OF UNEQUAL SIZE

Many designers of full-scale aircraft, observing that the lower wing always gets the short end of the stick, efficiency-wise, reduce its size and enlarge the upper wing. This raises overall wing efficiency while it retains the weight-saving advantage of wire bracing. Aerodynamically, such a bipe is a little closer to a more efficient monoplane. As you might expect, the greater the difference between the size of the two wings, the closer the combination approaches monoplane efficiency. This little ploy was simply one step down the ro



Note the cowl on this 68-inch-span, .60-size bipe. The rubber inlet air restricter prevents the engine from being over-cooled when flying during winter.

leading to strut-braced and, ultimately, unbraced monoplane wings, and it should be regarded with suspicion by dyed-in-the-wool biplane fanciers.

Enlarging the upper wing also raises the center of lift and drag. The result: a bipe that may handle more like a high-wing trainer (far from ideal for smooth, clean aerobatics). Enlarging the lower instead of the upper wing might make more sense for aerobatics, but it would produce a somewhat odd-looking bipe. This layout is rare in the full-scale world.

For a given maximum wingspan, wings with equal chords and spans have been found to be far superior to unequal-wing combinations. An equal-winged bipe with the same wingspan and wing area as a monoplane typically produces about 22 percent less induced drag than the monoplane. With a given wingspan, bipes can develop more lift with less induced drag than a monoplane—one of their strongest points. Their compact overall dimensions in relation to wing area is another bonus—a big help in making them more readily transportable in the average car.

If one wing has a shorter span, for best efficiency, its chord should be proportionally reduced by at least as much as its span. Theory says that the wing's chord should be reduced proportionally to the cube of its span, but, in many cases, this produces a chord that is too small to be practical. For example, if the shorter wingspan is reduced to 0.8 times the span of the longer wing, then the chord should be reduced to 0.8 to the third power, or about half the chord of the larger wing.

In the next installment, I'll look at triplane wings, bipe tail feathers, interplane strut design and offer tips on bipe fun-fly designs. See you then.

**Addresses are listed alphabetically in the Index of Manufacturers (for page number, see table of contents).*■

AIR SCOOP

CHRIS CHIANELLI

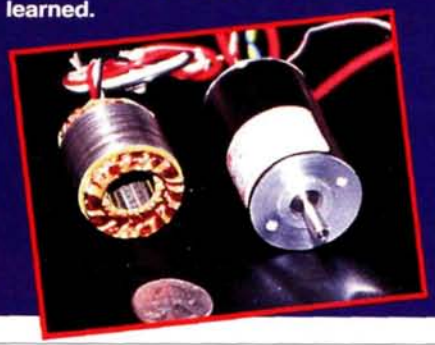
New products or people behind the scenes; my sources have been put on alert to get the scoop! In this column, you'll find new things that will, at times, cause consternation, and telepathic insults will probably be launched in my general direction! But who cares? It's you, the reader, who matters most! I spy for those who fly!

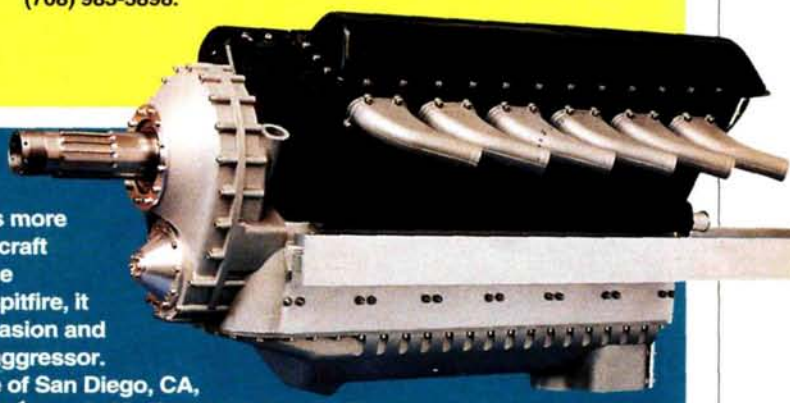
CHICAGOLAND
FESTIVAL OF GIANTS

The first Annual Chicagoland Festival of Giants takes place this July 15, 16 and 17 in beautiful St. Charles, IL, just 30 miles west of Chicago on Route 88. Come enjoy three days of summer R/C fun: fly off a 50x500-foot paved runway with parallel grass strips, peruse the manufacturers' displays and attend the Saturday night pig roast. RV camping sites are within walking distance of the flight line, and tents are available for overnight model storage and charging. Family attractions include: Pheasant Run Resort with dinner theater and golfing plus great boutique shopping and antique hunting along the picturesque Fox river. All pilot landing fees will be donated to the Disabled American Veterans benefit. For information concerning maps, motels, parking and pit passes, contact David Brady at (708) 466-9742; fax (708) 466-9744; or Don Bennish at (708) 983-7971; fax (708) 983-5898.

Leaving You Brushless

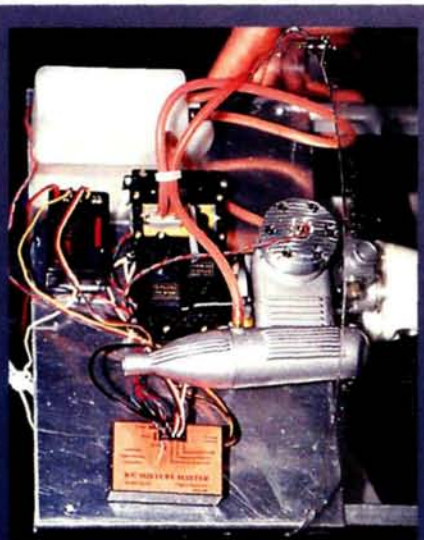
The prototype MAX 15 brushless motor and accompanying speed controller (not shown) represents the latest such entry to the R/C airplane market. Very high efficiency is claimed; call (716) 662-5651 for details. We'll keep you informed as more is learned.





The Rolls-Royce Merlin is more than just an aircraft engine. With the Mustang and Spitfire, it rose to the occasion and beat back the aggressor. Richard Mahue of San Diego, CA, recently ran this ¼-scale Merlin, which reportedly sounds very realistic. That would be something. Those who've had a close encounter with a P-51D in a flat-out low pass know what I mean. A four-blade scale prop is also currently being worked on. Production engines are not being produced as yet, but are possible, according to Richard. He is, however, interested at this time in selling castings for those who are interested in displaying this historic powerplant. Interested? Call Richard at (619) 268-8867, or write to him at 8867 Armorss Ave., San Diego, CA 92123.

Merlin on the Mantelpiece



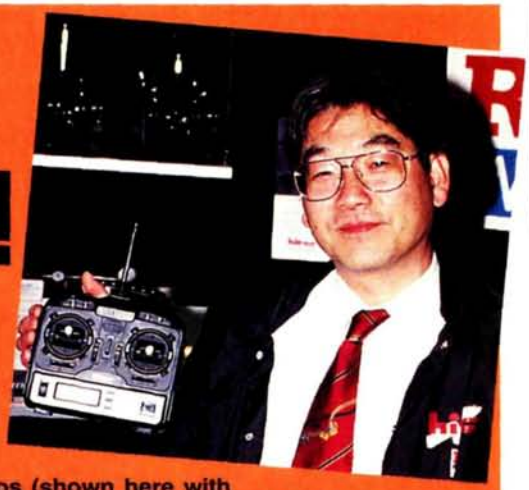
Guaranteed Airborne Power

Adaptive Engineering's R/C Mixture Master uses throttle setting (rpm) and combustion temperature (measured by glow-plug resistance) to set in-flight fuel mixture. After you've tuned the engine on the ground (the transmitter is used to set target values), the Mixture Master gives you consistent engine performance in the air. It also intelligently adjusts the needle: if rpm are down and temperature up, the unit richens the mixture. If that isn't enough, the unit also syncs rpm for multi-engine aircraft (with individual mixture adjustment). In a multi-engine role, this $90 unit is the first local area network for airborne model airplanes! For more information, contact Adaptive Engineering at P.O. Box 1691, San Bruno, CA 94066; (415) 871-7744.

PRECISION PULL

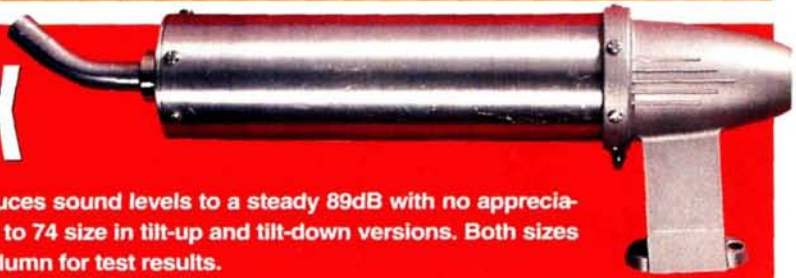
These new CNC-machined-aluminum servo wheels and Pull-Pull Wheels from Hangar 9 totally eliminate the flexing that often occurs with plastic servo arms and wheels. The Pull-Pull Wheels are grooved to accept 0.040-inch-diameter cable for a one-piece, positive-control system. The cable is locked into place with a 2mm setscrew that allows easy trim adjustment. The wheels are gold-anodized for that Hangar 9 touch of class. Distributed by Horizon Hobby Distributors, 4105 Fieldstone Rd., Champaign, IL 61821; (217) 355-9511.

Flash! It's Here!



At this year's Toledo Show, Hitec, the people who brought us the very easy to program 7-channel Prism, introduced their new 4- and 5-channel Flash Series programmable FM radios (shown here with Hitec president Chun Park). Both systems come with the RCD Supreme receiver, full Ni-Cd packs and HS-300 servos (three servos with the 4-channel and four with the 5-channel). These two-model-memory systems feature: digital trim memory and reset, end-point adjustment (CH-1, 2, 3, 4), exponential (CH-1, 2, 3, 4), mixing (elevon, V-tail, aileron/rudder), selectable mode-I/mode-II, auto engine cut-off, timer alarm and low-battery alarm. In addition to this, the Flash 5 includes: buddy-box capability, a dual-rate switch and a fifth channel for landing gear. Rumor has it that Flash Series prices may set new standards in the programmable-radio arena. This much is certain: the discounted price of the 4-channel system will break the $200 price barrier.

Quiet as a Fox



According to Fox, this new "Quiet" muffler reduces sound levels to a steady 89dB with no appreciable rpm loss. Available in 40 to 50 size and 60 to 74 size in tilt-up and tilt-down versions. Both sizes weigh 5.75 ounces. Watch Dave Gierke's "RPM" column for test results.

PILOT PROJECTS

A LOOK AT WHAT OUR READERS ARE DOING

SEND IN YOUR SNAPSHOTS

Model Airplane News is your magazine and, as always, we encourage reader participation. In "Pilot Projects," we feature pictures from you—our readers. Both color slides and color prints are acceptable.

All photos used in this section will be eligible for a grand prize of $500, to be awarded at the end of 1994. The winner will be chosen from all entries published, so get a photo or two, plus a brief description, and send them in!

Send those pictures to: Pilot Projects, Model Airplane News, 251 Danbury Rd., Wilton, CT 06897.

GENERATIONS OF R/C

Tom (right), Andrew (left) and young Kent Kerner, all of San Diego, CA, represent three generations of modelers who enjoy Midwest Products' models—the latest being this beautiful AT-6 Texan. Powered by a YS 120 4-stroke engine, the model is covered with fiberglass and painted with Southwestern Bell Telephone yellow automotive enamel. The markings are like those of a full-size Texan that was captured in France by the Germans during WW II and flown during the rest of the war by the Luftwaffe Squadron 6.

ON SILVER WINGS

Darrell Rohrbeck of Harrison Township, MI, scratch-built this Meyers OTW-160 biplane—a scale replica of the full-size plane he owned in 1946. The model has a wingspan of 52 inches and is powered by a Saito .45 4-stroke engine. The fuselage, the fin and the rudder are covered with balsa sheeting and chrome MonoKote. The wings and the stab are covered with Super Coverite and finished with Hobbypoxy paint. Details include a dummy engine, operational running lights, rib stitching, panel lines and simulated rivets.

JPX FROM JAPAN

Senji Watanabe of Fukuoka, Japan, sent this photo of the 104th model he has built. With its JPX turbine jet engine, it's a real sizzler. Designed by Yuji Oki, the Star Light weighs 13 pounds, has a 77-inch wingspan and is 67 inches long. It has a Futaba FC-28 radio and Giezendanner electric retracts. Construction is fiberglass for the model's fuselage and balsa-covered foam-core wings. Senji spent only four months building and finishing it.

BOEING 80A BIPE

Samuel Mossin of Santa Maria, CA, built this unusual Boeing 80A tri-motor biplane. An aerospace technician at Vandenberg Air Force Base, CA, and a member of the Tri-Valley R/C Club of Santa Maria, he first saw a photo of the Boeing in the "World Encyclopedia of Civil Aircraft," and he knew he had to build one. The 16-pound, 1/13-scale model is powered by a single O.S. 120 Surpass and has two freewheeling outboard engine propellers and shock-absorbing landing gear.

PILOT PROJECTS

MINUTEMAN F-86

This Jet Hangar Hobbies F-86 Sabre Jet, displayed here by Jennifer Lupton, was built by Joe Lupton of Newport News, VA. Powered by an O.S. Max .77 VR ducted-fan engine turning a Dynamax fan unit, the model has flown four very successful missions guided by an Ace R/C MicroPro 8000 transmitter and an RCD receiver.

The Sabre has in-flight mixture control and Rhom Air retractable landing gear. All the markings were painted on using frisket-paper templates, and BVM rub-on rivets add to the scale look of this miniature, 140mph Minuteman!

TROLL PATROL

Lloyd Snyder of Jonesboro, GA, built this specially equipped Lanier R/C Stinger for dropping paratrooper trolls! Powered

by a Zenoah G-62 with a Bennett smoke system, the Stinger has bomb-bay doors and a side door for loading the troops. Covered with MonoKote and guided by a Futaba PCM radio, the model is a really fun plane. Lloyd says, "Bubba has an excellent kit!"

FAMILY EXTRA

Mark Wood of Carlisle, MA, sent in this family picture showing his new Carl Goldberg Extra 300 and his three children: Brad (behind), Aimee (right) and Michelle (left). The model was a Christmas present from his wife; it took him only two weeks to frame it, but it took two months to apply the flawless MonoKote covering! The plastic parts are painted with Top Flite's LusterCote paint and the pinstriping is from Carl Goldberg. The rudder is controlled by pull/pull cables, and standard servos and a Futaba 6NFK FM radio control the model. An ASP 1.08 engine provides unlimited vertical performance, and Mark was very happy with it until he saw a friend's Extra 300 that's powered by a Webra 1.20 2-stroke! The Extra 300 is the perfect addition to any family.

MARVELOUS MODEL MITCHELL

This beautiful, 1/8-scale, B-25 medium bomber is the first scratch-built project of Mike Kirn of Wadsworth, IL. Built from Ziroli plans, the model is powered by two O.S. 1.20 4-stroke engines equipped with Perry Pumps and C&H ignition systems. The bomber also has Robart retracts, operable bomb-bay doors and bomb drop, navigation lights, landing lights, flaps, scale-engine detail and detachable wing panels that make transportation easy. To gather the necessary documentation for his impressive project, Mike took photos of the full-size Mitchell at Kermit Weeks' museum hangar.

CANADIAN SUKHOI

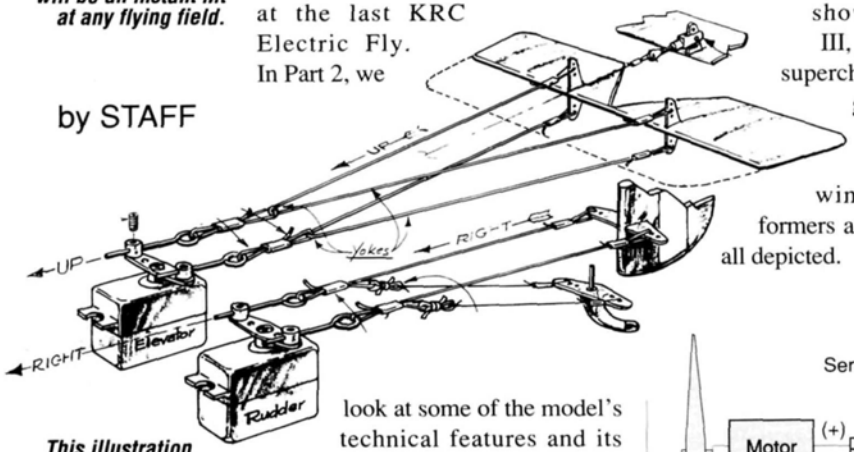
Brian Irwin of Calgary, Alberta, Canada, built this striking Soviet SU-26 Sukhoi from a WBI Fiberglassers kit. The black-and-purple aerobat has a 72-inch wingspan and is powered by a Q-42 gas engine. The model weighs 15 pounds.

The Dornier Zeppelin

Whether it's powered by an Astro geared .40 cobalt electric motor or a medium-size 4-stroke glow engine, the Dornier will be an instant hit at any flying field.

by STAFF

IN THE LAST issue, we presented an overview of Steven Stratt's beautiful, highly detailed, electric-powered Dornier Zeppelin D.I biplane, which took first in Scale at the last KRC Electric Fly. In Part 2, we look at some of the model's technical features and its outstanding flight performance.



This illustration shows the closed-loop pull/pull control system used on the Dornier D.I.

AIRDROME PLANS

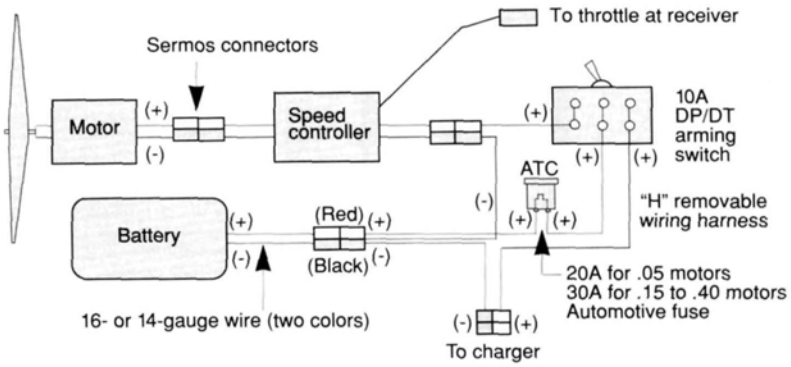
Steven Stratt's Airdrome Plans Service* is one of the best sources of plans of unusual and unique antique aircraft. There's hardly an empty space on any of Stratt's plans. Some assemblies are shown in perspective drawings. The Dornier Zeppelin D.I plans show complete details of the shock-absorbing landing gear and functioning cockpit controls, i.e., the stick and the rudder bar. Detailed drawings show a scale BMW III, 6-cylinder, 185hp, supercharged engine and give precise painting information. Full-size wing ribs, fuselage formers and tail feathers are all depicted.

GENERAL FEATURES

The plans are drawn to 1/6 scale, and an Astro 40 geared cobalt electric motor or a .46 to .53 4-stroke engine is ideal. The prototype model was electrically powered and covered with chrome Mono-Kote* and Solartex* cloth covering. The beautifully executed rivet details (which are intended to look realistic from a few feet away, not up close) were applied to the chrome finish with an electric engraving tool and a fine-tip stylus.

The plane is controlled by a Futaba* radio (S-133 servos). The model has pull/pull cable control in a unique "closed-loop" design that keeps cable tension constant. Simple eyelet-servo connections make adjustment to the control system simple and equalize tension on the control-surface arms (see diagram). A control-system diagram and a wiring schematic are included with each set of plans.

Steven informs us that he has revised the 1/6-scale Dornier D.I plans greatly. He has replaced the model's bent-wire cabane struts with carbon-fiber, reinforced-



Schematic of typical wiring layout of all Airdrome models over 05 size
(Note that with this setup, the speed controller is completely disconnected while charging.)

D.I Part 2

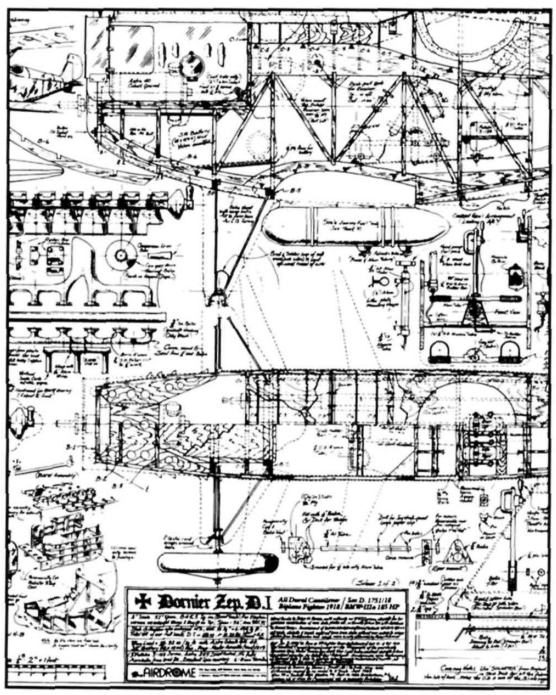
by DAVID C. BARON

This design is truly splendid for modeling. Its nose moment is long by WW I standards, but it's as clean as any racing design from the same period. The departure from scale is such that the wing is stretched by about 5 inches and the tail is slightly enlarged. The result is pure magic to fly.

Steven Stratt—designer of the Dornier Zeppelin D.I plans and owner of Airdrome—poses with his unusual model.

plywood construction. This greatly simplifies construction and simplifies the alignment of the upper wing without sacrificing strength. Though his plans depict older models, the building techniques Steven recommends are clearly up-to-date. For more information, contact Steven at Airdrome Plans Service, P.O. Box 1425, FDR Station, New York, NY 10022; (212) 421-1440.

**Addresses are listed alphabetically in the Index of Manufacturers (for page number, see table of contents).* ■



A small section of the Dornier D.I plans.

• Test flight

As with any truly beautiful scale aircraft, the moment of truth is in the test flight. Though I've tested many pretty planes throughout the years, there's no greater gathering of stomach butterflies than those brought on by the first flight of a plane of this quality. I don't feel sheepish about this, because it ensures a very thorough preflight. I've had the honor of testing a few of Steve's masterpieces and had confidence in his building and designing prowess. The area that's most scrutinized before flight is probably prop selection. It can make or break an electric airplane's performance. I've found that the best prop for a geared Astro 40 in an aircraft of this size is the Master Airscrew* wooden 12x9.

• Explanation

Owing to the increased use of gearboxes and direct-drive motors with higher torque, large, modern, direct-drive electric aircraft don't need to achieve the high rpm of their internal-combustion cousins. The ideal prop is therefore one that has greater pitch than those that are commonly available. You may ask: why not just use a prop with a larger diameter? Well, it's because duration drops off directly in proportion to diameter! So in a perfect world, we wish for props like 10x10, 11x11 and 12x12. (In case an enterprising manufacturer is reading this, these props should also be very light and very rigid. While I'm wishing, both fixed and folding would be nice.)

PHOTOS BY STEVEN STRATT & WALTER SIDAS

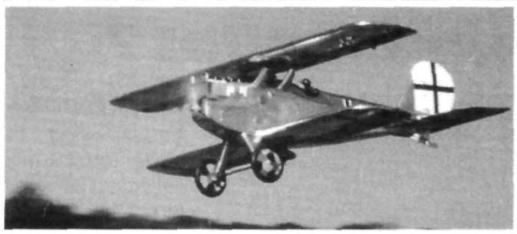
The Dornier's first test flight was at the FLYRC club field in Southbury, CT. "Simple Programming's" David C. Baron had the honor.

• Takeoffs

The D.I uses only about 35 feet of runway to get into the air. It behaves well on the ground, but just in case the wheels fall into a rut while it's rolling slowly, I hold full elevator for the first 20 feet and then slowly ease the elevator back toward neutral as speed builds. Liftoff occurs with just a little back-pressure on the sticks. If your plane has a wing loading that's similar to the original's, you will be pleasantly surprised by its aggressive climb.

• Stalls

This plane is very predictable throughout the stall. Again, if your wing loading ends up much higher than this version, allow for extra altitude to conduct your first tests.



Flight performance with a geared 40 electric motor is spirited; the model can do every trick in the book. It's flown at reduced power for scale-like, realistic flights.

• Landings

Owing to the design's lightness and substantial frontal area, it likes to be powered down for approaches and landings. This practice maintains good airflow over the tail as air speed decreases, and it greatly reduces the possibility of ground loops and nose-overs. It also provides you with a long, deep flare. Once perfected, this approach can give predictable three-point landings and smooth roll-outs every time.

• Overall characteristics, responsiveness, aerobatics

The Zeppelin most reminds me of the Great Planes* Super Aeromaster. Of course, it would be difficult to build an Aeromaster this light, but that's balanced by the reduced horsepower available from electric power. The plane is very smooth and responsive to the controls while being predictable throughout its flight regime. Loops, rolls and spins are all done with ease.

• Conclusion

This plane captures the spirit and feel of the original; its realism stems from its extra-large prop and gear ratios. These, coupled with the battery bundle that duplicates the mass of the original engine, make a model that truly replicates the original. All Rhinebeck fans will appreciate the beauty of a plane that looks and flies like a scale aircraft.

HOW TO

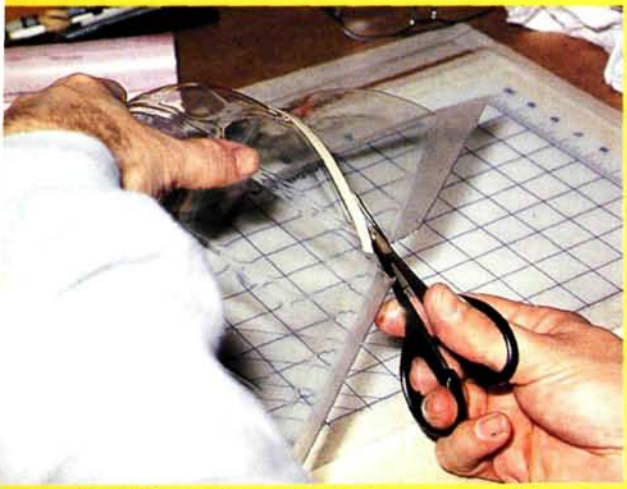
by RICHARD MUISE

Paint a Framed Canopy

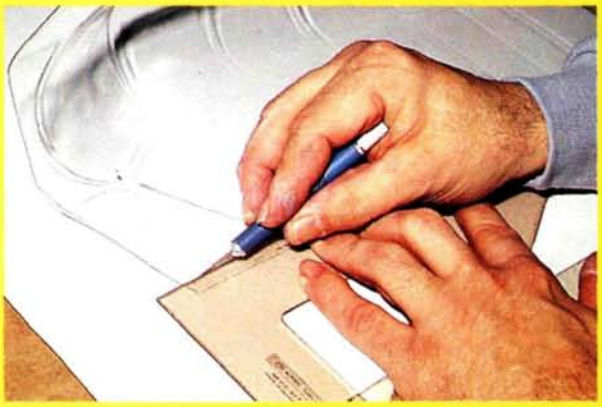
AIRCRAFT CANOPIES come in two basic forms: bubble, such as those on P-51s and Sea Furys, and framed, such as those on Hawker Hurricanes, Grumman Wildcats and Hellcats, and the AT-6 Texan's popular "Green House" canopy.

When a canopy has many panels and many identical frames, slight differences in their width can detract from an otherwise beautiful model. The technique described here will simplify your painting task and give you consistently straight frames of equal width. Because the subject model—a scale Texan—has a semigloss metallic-silver finish, the paint will be applied to the outside. For a shiny, high-gloss finish, you can also paint on the inside.

Let's get started.



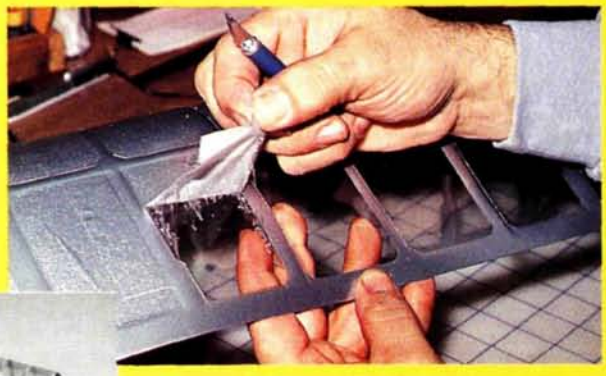
1. Using a sharp pair of scissors or small tin snips, remove the scrap material from the molded canopy. Lay a strip of masking tape along the cutting line to use as a guide. Cut slowly, and don't force the scissors; it's easy to slip and scratch the unmasked plastic.



2. Using a fine-tip marking pen and a straightedge, mark the outside of the canopy where the final cuts will be made. Use a pair of long-nose pliers to break the tip off a sharp hobby knife. With the tip removed, the blade will be less likely to "wander," and this will give you a much straighter cut. Working slowly and carefully, make several light cuts on the inside along the line until you've cut about halfway through the plastic. Bend the plastic back and forth until it breaks along the scored line. For a smooth, straight finish, sand all the rough edges using 220-grit sandpaper and a sanding block.

5. Mist a light coat of silver paint over the canopy, and allow it to dry for a few minutes before you apply any more. If you use Coverite's* 21st Century spray paint, apply many thin coats instead of one or two heavy coats. When you've applied enough coats to provide a good, solid finish, set the canopy in a dust-free area until it's completely dry (two to four hours for 21st Century).

6. Below: using the tip of your hobby knife, carefully lift the corner of each masked area and remove them. Work slowly and carefully so you don't scratch the paint or the windows. Some cheaper tape (cheaper is OK) will leave a sticky residue on the clear plastic. You can easily lift this off using another piece of tape; the tape will remove the residue, but it won't lift off the paint. You can also use rubber-cement thinner and a cotton swab.

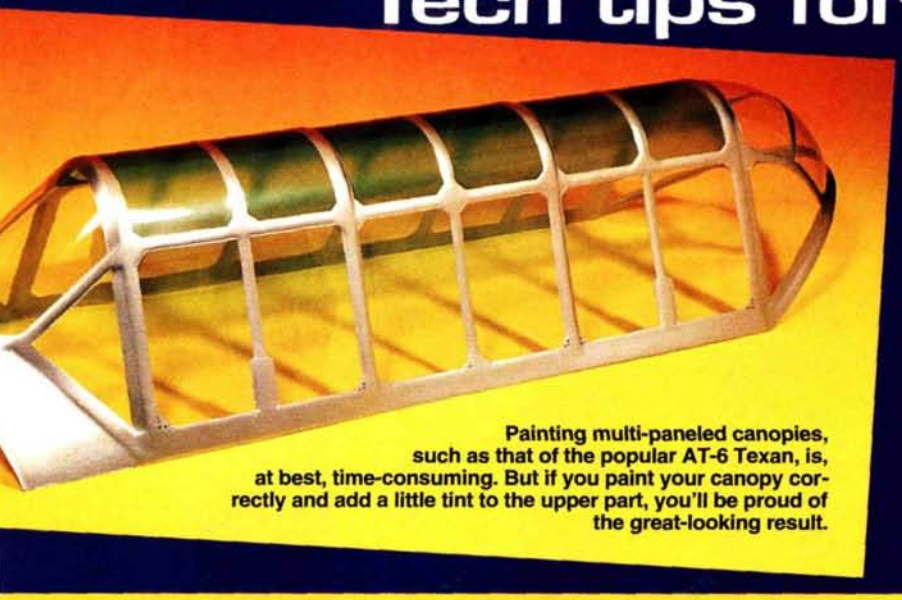


PHOTOS BY LISA KNORRA

MATERIALS

- Lexan scissors
- 220-grit sandpaper and a sanding block
- Hobby knife and extra blades
- Masking tape: ¼, ½, ¾ and 2 inches
- Masking paper (brown wrapping paper)

Tech tips for professional results



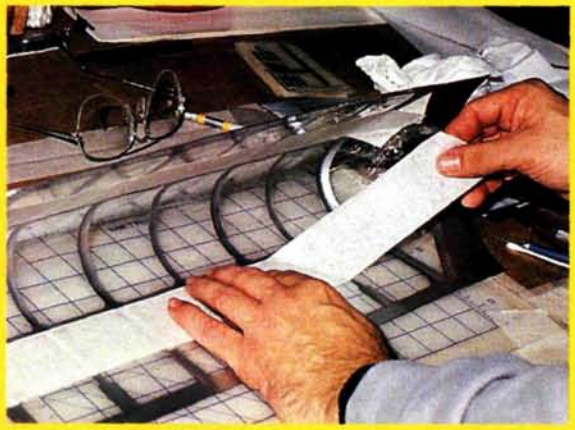
Painting multi-paneled canopies, such as that of the popular AT-6 Texan, is, at best, time-consuming. But if you paint your canopy correctly and add a little tint to the upper part, you'll be proud of the great-looking result.

All that's left is to position the canopy on the model and screw it onto the fuselage. Coverite 21st Century paints are fuelproof up to 15-percent nitro, and because the tinted area is on the inside, it's well-protected from the elements.

3. Left: use a tack cloth to clean dust off the canopy. Then, using a photo of the actual airplane for reference (a good set of three-views will do), mask off the frames with 1/4- and 3/8-inch-wide masking tape (3/4-inch-wide tape cut in half). Use 1/2-inch-wide tape along the bottom edge. Take your time, and make sure that the tape is straight. If your canopy has raised frames molded in, use them to guide you as you position the tape. If you have an AT-6, you must also mask off the corner gussets for each window.

4. Left: using 2-inch-wide masking tape, mask off all the areas that should be clear. Carefully butt the 2-inch tape against the frame tape, and smooth it into place and, using your fingernail, press it into the edges of the frame tape. Then use your hobby knife to cut away any overlapping tape. When all the windows have been covered, remove the thin strips of frame tape, and burnish down the rest of the tape.

7. Left: using a paper towel moistened with a weak solvent, remove any overspray from the inside of the canopy. I use a 50:50 mixture of acetone and rubbing alcohol, which slowly removes the overspray mist, but doesn't attack most clear plastics. Before you use it, though, test it on a scrap piece of canopy material to make sure that the solvent won't harm the plastic. After the canopy has been cleaned, cover the outside surface with clear plastic wrap to protect it from being scratched while you work on the inside.



8. Left: wipe the inside of the canopy using a tack cloth. Then apply masking tape along the line for the tinted area. Press the tape down firmly, and finish masking the interior with masking tape and paper.

9. Left: using an airbrush with a wide fan-pattern tip (I use a Paasche* AU-70), lightly apply your tint color. Use a smooth, nonstop motion to obtain a uniform finish and to prevent some areas from getting too dark. Tint colors can become dark very quickly; a few coats will go a long way. I use clear "candy" lacquers to tint, but you can experiment with other materials and paints. Lacquers dry almost immediately, and the masking tape can be removed right away.

10. As a final touch, you may reproduce the small rivets and screw heads on the outside of the canopy frames using dark gray paint and a toothpick whose point has been sanded off. On this canopy, I just picked out the rivet details on the bottom canopy frame.

Painting your own canopy is both challenging and rewarding. There's nothing like showing up at the flying field with a great-looking model that has a beautifully painted and tinted canopy. But for many, painting isn't practical. If you'd like a professionally trimmed and painted canopy for your next model, you can contact me at Motion Graphics, 2645 Robert Arthur Rd., Westminster, MD 21157; (410) 848-0008.

**Addresses are listed alphabetically in the Index of Manufacturers (for page number, see table of contents).* ■

- overite 21st entury silver ray paint
- Light-blue or green "candy" clear laquerpaint
- Paint thinner and rubber-cement thiner
- Tack cloth
- Clear plastic wrap
- Airbrush
- Overspray solvent (acetone and rubbing alcohol)
- Respirator
- Cotton swabs
- Toothpicks
- Straightedge

MODEL AIRPLANE NEWS
FIELD & BENCH REVIEW

GREAT PLANES

Ultra SPORT 40 ARF

by STEPHEN SCOTTO

ARF AEROBAT

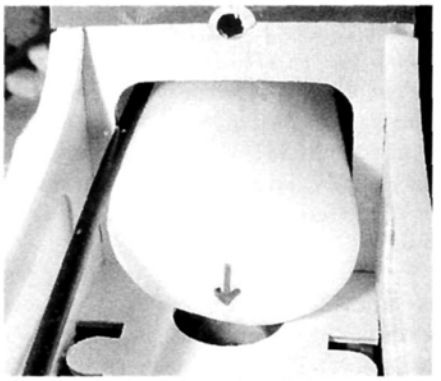
HAVE YOU EVER noticed how some guys show up with a new airplane every other week? Others manage to finish one or two kits a year. I love to build, but somehow, my plane-building speed is closer to that of a turtle's than a hare's. Enter Great Planes'* Ultra Sport 40 ARF—a continuation of the popular Ultra Sport series of balsa kits and a very capable airframe that can be assembled quickly.

I go way back with the Ultra Sport. I built a balsa Ultra Sport 40 a couple of years ago and, since then, I've used it as my "everyday" airplane. It's sturdy and predictable, and its graceful appearance makes it exciting to fly. But the years have taken their toll, and after more than 300 flights and a few rough landings, this tough old bird has begun to show signs of wear. I was looking for a replacement, and the ARF version filled the bill.

The kit is a high-quality product that reflects the new wave of thinking in design and packaging. All the major components (fuselage, wing halves and tail surfaces) have been built on jigs. The balsa-and-ply framework is covered with a finished, laminated foam sheet that helps to strengthen the structure. All fittings, e.g., fuel tank, wheels, spinner, pilot figure, pushrods and engine mount are included. The Ultra Sport 40 ARF is designed as a tail-dragger, and installing retracts is optional.

CONSTRUCTION

First, read the instructions carefully. Construction begins with the wing assembly, so you'll have to decide whether or not to install retracts. (The instructions include separate sections for fixed gear and retracts.) The fixed-gear wire is secured with hardwood blocks that screw into the wing. All the parts for the fixed gear are included. I decided to install retracts, and I used the recommended Hobbico* mechanical retracts. They're inexpensive and sturdy enough for a 40-size plane. The plans include accurate templates for the retract pushrods.

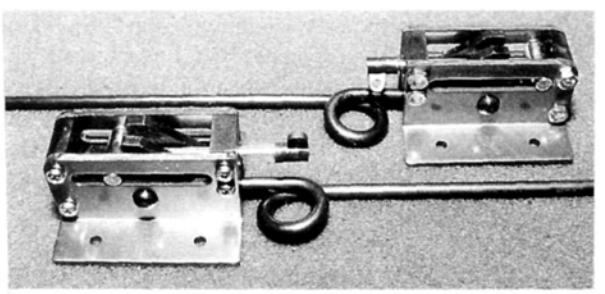


The fuel tank has been installed (a tight fit). Make sure the vent tube faces upward!

The wing halves are held together with a laminated plywood joiner and a balsa aft joiner. The wing center rib is also laminated plywood, and it supports the joiner, the retract servo and the wing-mounting dowel. First, create the openings for both servos by cutting away the foam. I cut away enough to allow access to the retract servo. Next, I laminated the wing center ribs and the wing joiner. I also jumped ahead in the plans and laminated the wing hold-down plate. Since I planned to install retracts, I had to cut away portions of the first two ribs in both wings to allow room for the pushrod and the servo. Using Pacer's* Z-Poxy, I glued the center ribs to the right wing half, added the joiners and joined the halves.

RETRACT-INSTALLATION HINTS

The retract installation took a little fiddling. I trimmed the fairing around the gear wells.



Hobbico mechanical retracts—simple and easy to install.

SPECIFICATIONS

Model name: Ultra Sport 40 Custom ARF
Manufacturer: Great Planes Model Mfg. (for more information, contact Great Planes Model Distributors)
List price: $299.99
Type: low-wing sport/aerobatics trainer
Wingspan: 55 in.
Wing area: 566 in.
Weight (dry): 6 lb., 6 oz. (advertised as 5.25 to 6 lb.)
Wing loading: 26 oz. per sq. ft.
Length: 49.5 in.
No. of channels req'd: 4/5 (throttle, ailerons, rudder, elevator, retracts—optional)
Rec'd. engine: .40 to .46 2-stroke, .60 to .70 4-stroke
Engine used: O.S. .46 SF BB ringed

Features: kit includes steel rod-in-tube pushrods, adjustable engine mount, hardware, factory-installed wheel wells and retract mounting rails, polyfoam base/plastic composite skin and detailed, photo-illustrated instructions.

Hits

- Excellent overall ARF design.
- Well-engineered adjustable motor mount.
- High-quality components.
- Excellent aerobatic flight performance (also flies well in choppy air).
- Simple, effective retract instructions.

Misses

- Instructions for assembling the wing-mounting-bolt reinforcement plate are out of sequence (see text). Manufacturer has now corrected this.
- Nylon bushings for steel pushrods had to be replaced.

The gear wire must be cut to length with a Dremel cutoff wheel (or equivalent) and test-fit in the wing. I made the retract pushrods exactly as shown in the plans, and they fit perfectly the first time. (Hey, how about that?) The servo-tray support is simply a plywood plate supported by two balsa blocks. These blocks are quite small—so small, in fact, that I had trouble finding them in the kit. By cutting a hole in the bottom of the wing, I made room for a conventional servo that I could use for the retracts.

The kit-supplied foam wheels are light and on the soft side. They're about 2.25 inches in diameter and fit snugly in the wheel well. They were so tight that any misalignment caused by a less-than-perfect landing would jam the wheels. I threaded the wheels onto a 6-32 bolt and chucked the bolt in a drill. To create more room, I sanded about ⅛ inch off the wheel's diameter.

WING FAIRING

The wing fairing was next, and this is where the retract instructions omit an important step. Although it's shown in the fixed-gear installation, the retract instructions don't include the installation of the wing-bolt reinforcement plates. Unfortunately, I followed the instructions and installed the fairings without including the reinforcement around the bolt holes. Yes, it was annoying. I had to create a slot in the fairing so that I could slip in the plywood wing-bolt plates. Go ahead and glue these plates on before you install the fairing.

AILERON-SERVO INSTALLATION

The aileron servo installation is straightforward. I assembled a simple plywood mount and installed it in the wing. The pushrods are another story. I like to secure everything with Z-bends; they're durable, and they have no parts that can become loose. The pushrod wires supplied with the kit are very stiff, and I couldn't form them into Z-bends. The instructions tell you to make a simple 90-degree bend and secure the rod to the servo arm with a plastic keeper that's provided. This works, but make sure you use tubing to lock the keeper in place. Inspect the keepers every time you assemble your airplane. This is a must!

The servos are mounted in the fuselage as shown.

FUSELAGE

First, I installed the engine. This kit uses a new adjustable engine mount that's very well-designed. It fits most .35 to .70 2-stroke engines, and it's long enough for a 4-stroke. The engine mount is designed to hold a nose gear, and I believe it will become a standard fitting.

After I had mounted the engine, I used Z-Poxy to attach the wing-mounting plate and the stabilizer platform. The instructions suggest the old tried-and-true technique: install the wing-mounting bolts from the bottom, and use a drop of paint to mark the spot on the wing where holes should be drilled.

FLIGHT PERFORMANCE

The first flight was made under conditions that really tested the aircraft. It was a cold, windy day late in December. After I had inspected the aircraft's systems, checked the fuel and range-checked the radio, I tested the retracts. They worked perfectly. The O.S. 46 started after a few turns, and a few minutes of needle adjustment resulted in a satisfactory high end and solid idle. I coaxed a friend out of his warm car, and we carried the Ultra Sport 40 ARF to the runway and pointed it into the wind.*

• Takeoff and landing

Throttle was applied, and a perfect takeoff followed. The Ultra Sport 40 ARF tracked straight as a steel rule into the wind, lifting its tail at about 25 feet. I kept it running on its mains for about another 50 feet, when a little back pressure on the stick put it into a gentle, realistic climb. I flew a few passes for trim, and only one click of elevator trim was needed.

At the end of the test flight, I brought the Ultra Sport 40 ARF onto the downwind leg, dropped the gear and throttled back. It settled into a solid, descending groove as I flew a gentle turn to line it up with the runway. The mains touched down, and the Ultra Sport 40 ARF rolled smoothly to a stop. The wind was worse for the second flight. Our field is on a hilltop, and a wicked rolling wave builds over both ends of the field. I gave it a shot anyway, and the Ultra Sport 40 ARF made it off without a mishap.

• Low-speed performance

This airplane is designed to fly relatively fast (in the pattern-trainer tradition) and isn't intended to be "loafed around." Nonetheless, the ship could be controlled at a relatively low speed. At low speed, there's a noticeably high angle of attack and a high sink rate. Stalls are straight ahead.

• High-speed performance

When I opened up the throttle, I didn't have to make a trim change. The Ultra Sport 40 ARF doesn't seem to get blown around in the wind, and it flies through choppy air in a predictable manner.

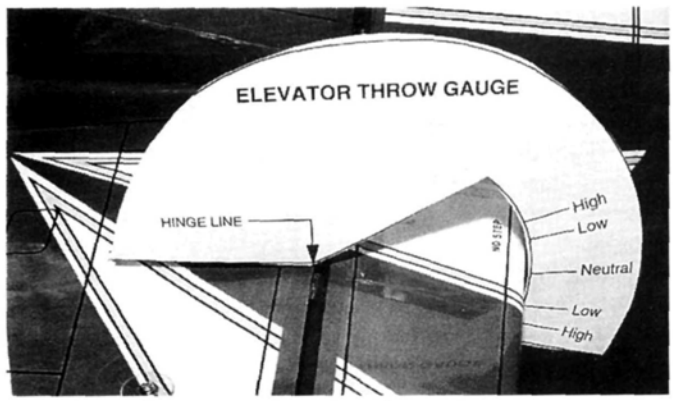
• Aerobatics

I flew a novice pattern to check the basic flight performance. It tracked beautifully through rolls and loops. The stall turn was easy and predictable, and the long tail smoothed out the roughness in the air.

Rolls are relatively axial but they do require some minimal down-elevator when the ship is inverted. Vertical performance is good with the .46, but it will not track upward forever. I tried a few spins, and the performance was crisp and predictable.

I had a fast landing, and then a problem became apparent. The wheels touched the grass on the far side of the main runway and were torn out. I mean the retracts came out cleanly. The retract mechanism and the mounting rails stayed behind on the field while the rest of the airplane bellied to a stop. There was no rib damage whatsoever and only some minor tearing of the covering!

An inspection revealed that the mounting rails had been inadequately braced to the rib structure. The braces were very small, and not much glue had been used. It took one evening to repair everything and that included adding extra tri-stock. If you build an Ultra Sport 40 ARF, check this area before you attach the retracts. It is easily reinforced, and either the manufacturer or owner/operator should do so. I love this plane!



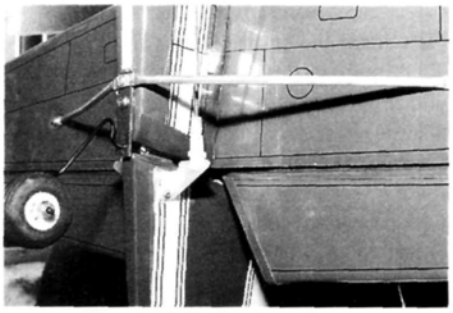
Templates make surface-throw setup easy.

(First, make sure the wing is in the right place.) The tail is assembled in the following sequence: stabilizer, vertical fin, fairing, tail gear, rudder and braces. Everything went together quite nicely. Don't forget to use the reinforcements where the braces are attached to the stab.

RADIO INSTALLATION

Don't install the radio first, or you won't be able to install the fuel tank. Install the switch first, then the servos, the throttle pushrod, the tank, the radio and the batteries. The fuel tank is nicely made, but it will not fit upright in the narrow tank compartment. Test-fit it carefully, and make sure the vent tube sticks straight up in the tank.

The rudder and elevator pushrods presented a few problems. The pushrods are 1/16-inch-thick steel wire that run through 1/8-inch nylon tubes. To make bushings for these wires, a piece of nylon pushrod is also supplied. You're supposed to cut the nylon



Note the tail wheel and braces.

pushrod into pieces and distribute them along the wire pushrod, but the diameter of the nylon pushrod was too small for the wire. I solved this problem by using a larger piece of nylon pushrod that I had in the shop. *[Editor's note: this was an isolated case in the initial kit run; it has been corrected.]* The wire was also difficult to bend, so I used the supplied pushrod keepers to secure the wire ends to the servo arms. All the other fittings supplied were of high quality, and I didn't hesitate to use them.

Finishing steps included mounting the cowl, installing the pilot and the canopy and balancing the aircraft. I glued the cowl together with Pacer Technology's* Slo-Zap, painted the pilot and used Zap-a-Dap-a-Goo to attach the canopy.

The plane's CG is 4 inches behind the leading edge. (The instructions for balancing are excellent.) I put about 7 to 8 ounces of lead in the nose and made sure the weight was securely attached to the airframe with screws.

Great Planes provides neat little guides for setting up the control throws. Just cut out the simple paper templates and hold them against the control surfaces. This system works very well.

CONCLUSION

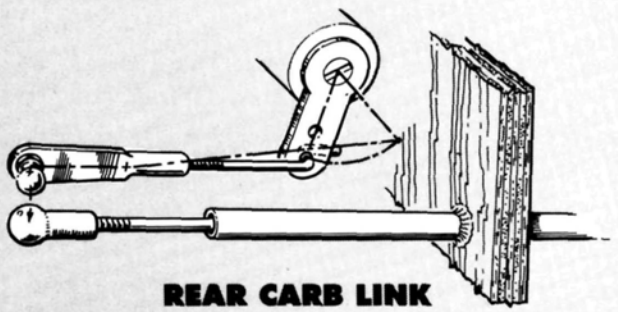
The bottom line is that the plane looks great, and it flies beautifully. I assembled it in a couple of sessions, and it should last a long time. This is a great airframe for someone who is just out of the beginner stage. Treat it with respect, and it will make a great tutor for advanced flying. As a tail-dragger advanced trainer, it's without equal. Save the wear and tear on the scale ships and have a ball flying the Ultra Sport 40 ARF. Too many fancy planes end up staying at home when the wind begins to blow. This one has no trouble flying in chop. Instead of huddling in the shack, stand tall on the flight line! The Ultra Sport 40 ARF can take it.

**Addresses are listed alphabetically in the Index of Manufacturers (for page number, see table of contents).* ■

HINTS & KINKS

JIM NEWMAN

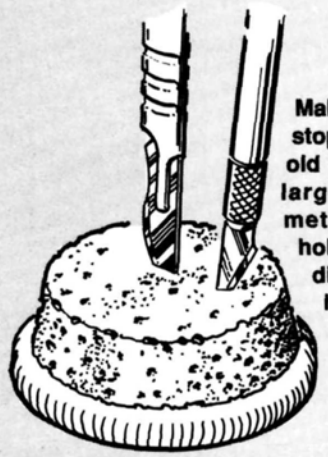
***Model Airplane News** will give a free one-year subscription (or one-year renewal if you already subscribe) for each idea used in "Hints & Kinks." Send a rough sketch to Jim Newman c/o **Model Airplane News**, 251 Danbury Rd., Wilton, CT 06897. BE SURE YOUR NAME AND ADDRESS ARE CLEARLY PRINTED ON EACH SKETCH, PHOTO AND NOTE YOU SUBMIT. Because of the number of ideas we receive, we can't acknowledge each one, nor can we return unused material.*



REAR CARB LINK

Rear-mounted carburetors are often too close to the firewall to allow the pushrod to be connected properly. Fit a ball link to half a clevis, then screw in a wire Z-bend. This short link transfers the motion back to the throttle arm in a smooth, swinging motion.

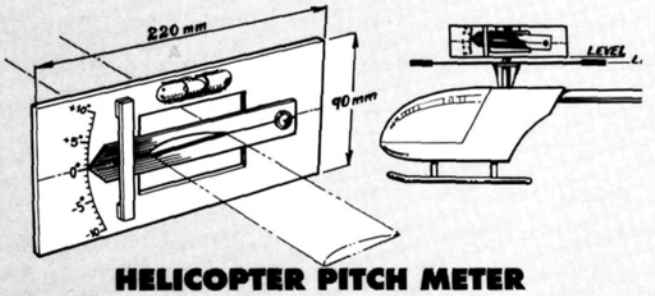
Ken Blasius, Garden Grove, CA



CORK KNIFE HOLDER

Make this out of a large cork stopper, such as one from an old picnic Thermos®, or glue a large cork block to a heavy metal base. Make two knife holders, and paint them with different colors; use one to hold sharp, ready-to-use knives and the other to hold knives that need sharpening.

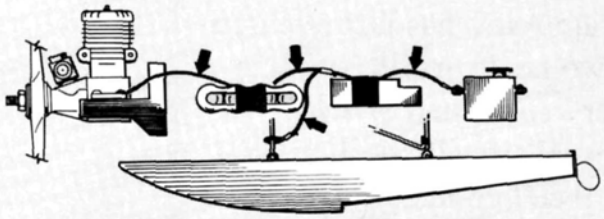
Lloyd Ressler, Gerrards Cross, Bucks., England



HELICOPTER PITCH METER

Make this pitch meter out of 1/16-inch-thick plastic that has a bubble level glued to it. The level should be centered when the base of the pitch meter is level and parallel with the flybar. Slip the pointer over the rotor blades, at the same station on each blade; then adjust the blades' pitch until they're at the same angle.

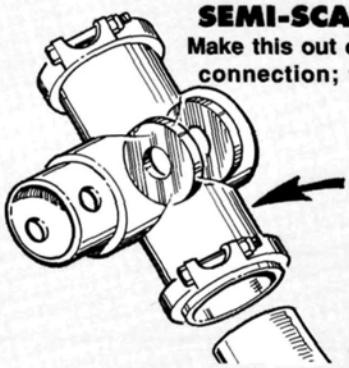
Wilson Wippel, Parana, Brazil



FLOATPLANE SAFETY CABLE

To avoid losing valuable accessories in a crash, tie them together with heavy fishing line or U-control cable that runs from an engine lug to the battery pack and receiver, etc., and finally loops around the float struts. (We hope the floats will always stay afloat.) To facilitate equipment removal, use fishing swivels to attach the equipment to a main cable.

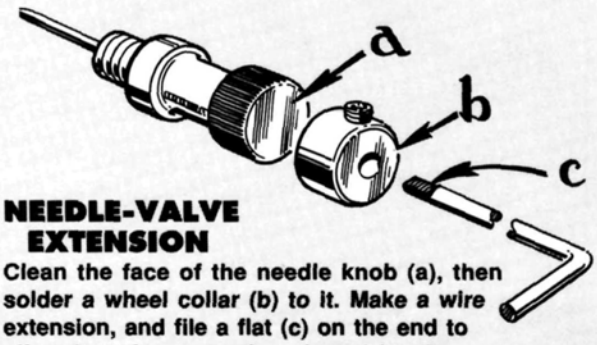
Ed Russell, Orange, CA



SEMI-SCALE DISPLAY PROP

Make this out of a four-way PVC plumbing connection; for 1/4 scale, use a 1-inch-diameter connection. Make details with various sizes of plastic tubing, and carve the prop blades out of basswood. Glue in a couple of PVC sheet or plywood washers so that it will fit on the engine's output shaft and be loosely held by the prop nut, which will need a tube wrench. Use clear PVC pipe cement to join the pieces, then paint everything silver.

Don Frisbie, Wichita, KS



NEEDLE-VALVE EXTENSION

Clean the face of the needle knob (a), then solder a wheel collar (b) to it. Make a wire extension, and file a flat (c) on the end to allow it to be properly gripped by the wheel collar's setscrews. When the engine is switched between models, this setup allows the use of extensions of various lengths.

Manuel Torres, Milton, FL

.40 TWO-STROKE ENGINE GUIDE

Two-stroke .40ci glow engines are so popular that many manufacturers make multiple models. This guide is intended to allow you to quickly access some of the most important features of these engines. It isn't a performance comparison of any sort. We leave that to Dave Gierke's "RPM" column and Mike Billinton's engine evaluations. You may, however, quickly glance at one very important feature—price—and see how far your money will go in getting you the features you prefer.

We could have used the list price for comparison were it not for the fact that widely varying discount structures used by manufacturers and distributors in the industry render them all but useless. Instead, we used everyday mail-order prices—not "super close-out special," rock-bottom ones—for comparison. Don't run to your local hobby shop with this article in hand, screaming, "You're overcharging me; it says here an Enya SS .40 should cost only $90!" If the hobby shop is a high-volume store and the dealer is a good businessman, chances are he can come close to or even meet that price. On the other hand, if the store is in a town on the side of Mount Everest with a population of 250, expecting him to meet this price is a bit unrealistic. It can't be overemphasized: the prices here are for engine-to-engine value comparisons only. If you see that an engine is missing from the list, either the manufacturer/distributor failed to supply samples or information, or the engine is no longer produced. Nevertheless, we think the chart is very comprehensive and hope that it serves you well.

• by Chris Chianelli •

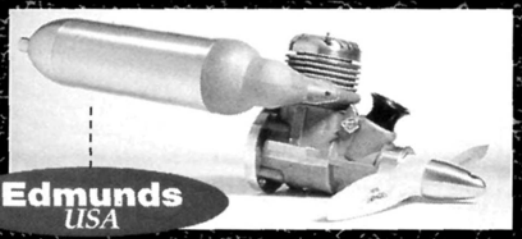
ENGINE VALUE COMPARISON

Engines	Piston Sleeve	Carb. Type	Porting	Conrod	Crank Support	Muffler Type	Weight w/Muffler oz.	Approx. Cost	Miscellaneous
ASP 40	ABC	TN	Schn	Bsh	BB	EX	14.91	$86	• • • • • • •
Enya SS 40	LI & S	AB	Schn	Bsh	Brnz	EX	14.47	$90	• • • • • • •
Enya SS BB 40	LI & S	TN	Schn	Bsh	BB	EX	14.34	$125	New TN carburetor
Enya CX 40	AAC	TN	Schn	Bsh	BB	EX	15.82	$150	• • • • • • •
Fox 40	LI & S	AB or TN	Schn	Bsh	Brnz	EX	12.12	$65	• • • • • • •
Fox BB 40	ABC	AB or TN	Schn	Bsh	BB	EX	11.97	$87	Spinner included
HP Gold 40	C-ring	TN	Schn	Bsh	BB	EX	12.02	$130	Chromed-brass liner
HP Silver 40	C-ring	TN	Schn	Bsh	BB	EX	11.96	$100	Chromed-steel liner
Irvine 40	D-ring	AB	Schn	Bsh	BB	EX	15.17	$105	• • • • • • •
Irvine Q 40	ABC	TN	Schn	Bsh	BB	EX w/B	16.76	$150	• • • • • • •
K&B 40	D-ring	MR	CFS	Bsh	BB	EX	13.40	$80	Breakaway shaft
Magnum 40	ABC	TN	Schn	Bsh	BB	EX	15.08	$75	• • • • • • •
MDS 40	ABC	TN	Schn	Bsh	BB	EX	14.67	$84	Plug wrench incl.
MECOA Zeus 42	ABC	MR	Schn	Bsh	BB	EX	15.26	$80	• • • • • • •
MECOA Stas's 42	LI & S	AB	Schn	Bsh	Brnz	EX	13.31	$48	• • • • • • •
Merco 40	ABC	TN	CFS	Pln	Brnz	EX w/B	11.65	$69	• • • • • • •
OPS 40 Pattern	ABC	SV	Schn	Bsh	BB	EX	15.94	$200	Stuffed crankcase
O.S. FP 40	ABC	AB	Schn	Bsh	Brnz	EX w/B	11.54	$73	• • • • • • •
O.S. SF 40	ABC	TN	Schn	Bsh	BB	EX w/B	16.15	$125	• • • • • • •
RJL GF 40	C-ring	TN	CFS	Bsh	BB	EX	17.97	$90	Octiporting
Rossi 40	ABC	TN	Schn	Bsh	BB	EX w/B	17.17	$130	• • • • • • •
Royal 40	ABC	TN	Schn	Bsh	BB	EX	16.18	$70	• • • • • • •
SuperTigre 40	C-ring	TN	CFS	Bsh	BB	EX	16.99	$90	Adj. muff./carb arm
Thunder Tiger GP	ABC	AB	Schn	Bsh	Brnz	EX	11.19	$60	• • • • • • •
Thunder Tiger Pro	ABC	TN	Schn	Bsh	BB	EX w/B	16.37	$95	• • • • • • •
TSI 40	ABC	TN	Schn	Bsh	BB	EX w/B	15.72	$95	Spinner included
Webra SI 40	C-ring	TN	CFS	Bsh	BB	EX	12.33	$75	Adj. carb arm
Webra Sp 40	ABC	TN	Schn	Bsh	BB	EX	15.19	$135	Adj. carb arm
RACING ENGINES (NO THROTTLE)									
Edmunds 40	ABC	Open venturi	Schn	Bsh	BB	TM	17.63	$325	Perry carb optional
Hett 40	ABC	SVCO	Schn	Bsh	BB	TM	19.09	$200	TN carb optional
Nelson 40	AAC	BVCO	Schn	Bsh	BB	TM	17.12	$325	Perry carb optional
Webra Q 40	ABC	SVCO	Schn	Bsh	BB	TM	16.46	$190	• • • • • • •

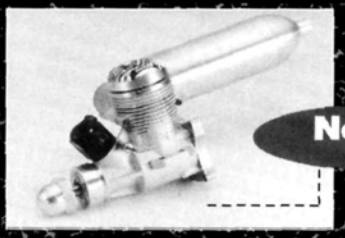
KEY

AAC—alum. piston w/chrome-plated alum. sleeve
AB—air bleed
ABC—alum. piston w/chrome-plated brass sleeve
BB—ball-bearing main
Brnz—bronze-bushed main
Bsh—bronze-bushed
BVCO—barrel-valve cutoff
CFS—cross-flow scavenging
C-ring—compression-ring w/steel sleeve
D-ring—dykes ring w/steel sleeve
EX—expansion chamber
EX w/B—expansion chamber w/internal baffle
LI & S—lapped iron piston w/steel sleeve
MR—mid-range adjustment
Pln—plain
Schn—Schnuerle-type or multi-port
SV—slide valve
SVCO—slide-valve cutoff
TM—tuned muffler
TN—twin needle

RACING ENGINES



Edmunds
USA



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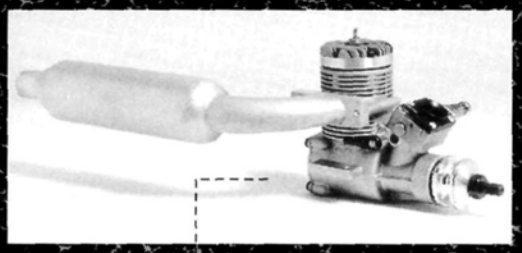

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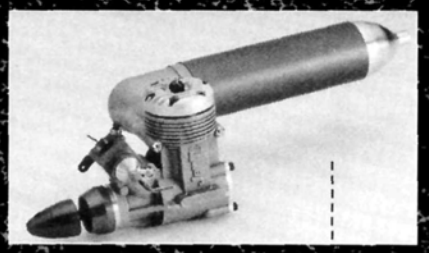

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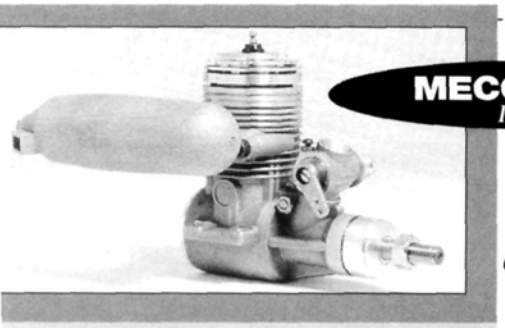
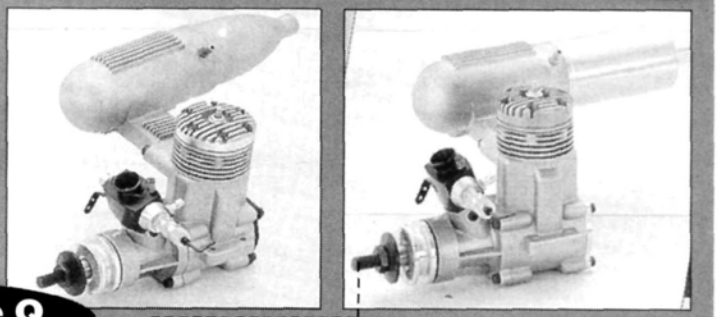
USA

Rossi
Italy



MECOA Zeus
Russia



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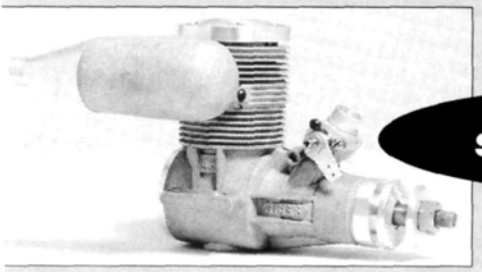

MECOA Stas's Bushing
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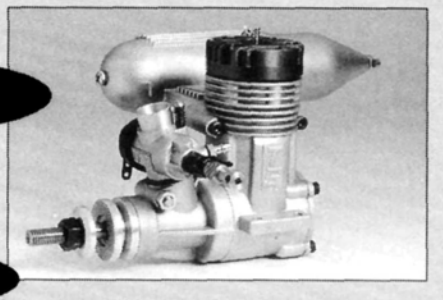

40 Irvine
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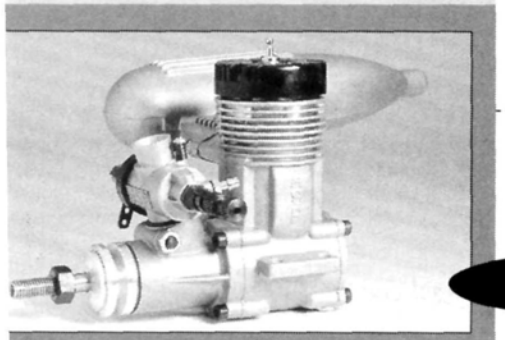
TSI
China



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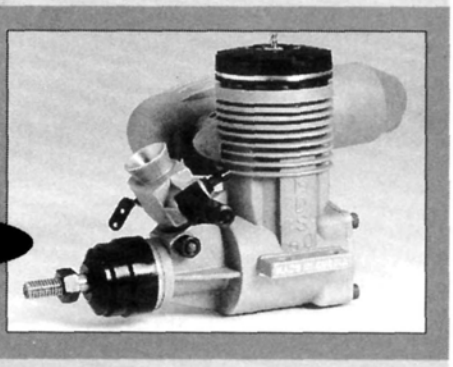

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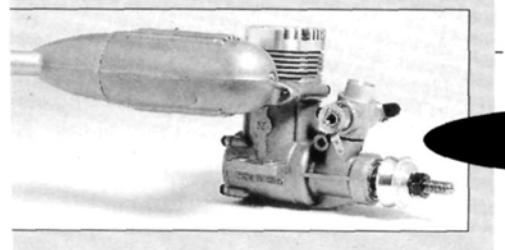

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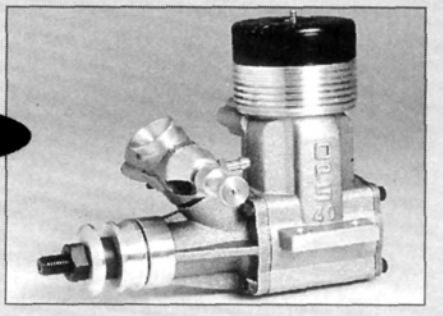
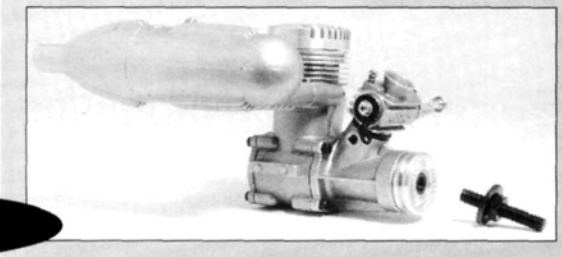


OPS
Italy

SuperTigre Ring
Italy



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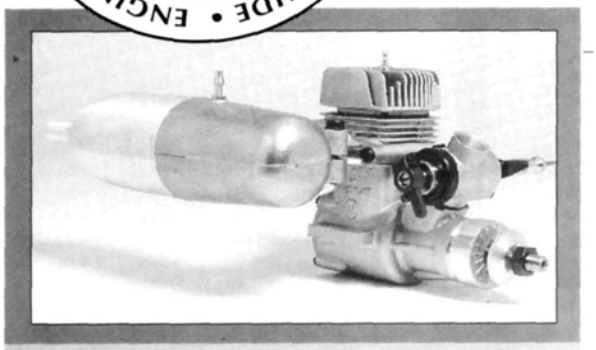
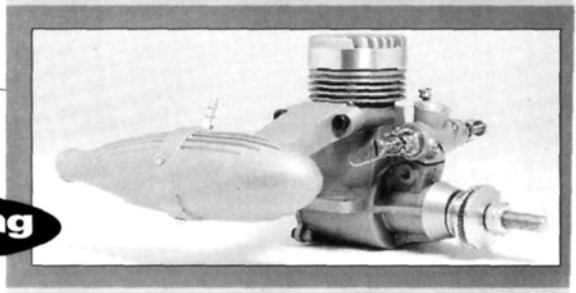
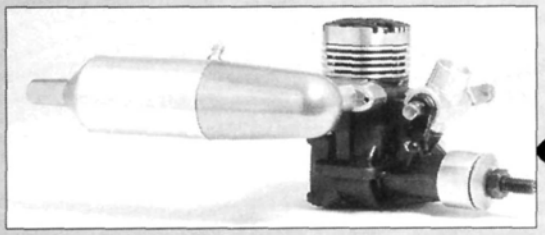




Fox Bushing
USA



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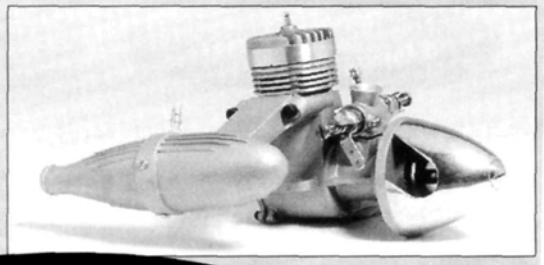

Fox BB Deluxe
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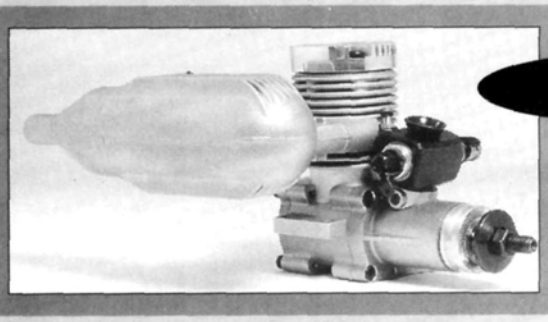
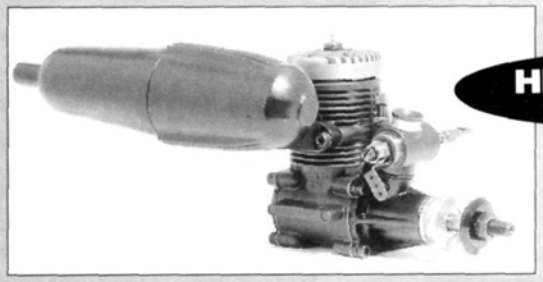
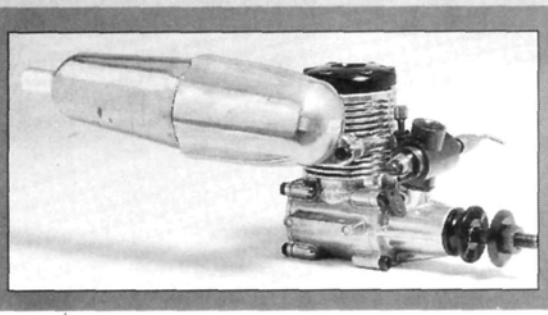


RJL GF
USA



HP GoldCup
USA/Austria



HP Silver Star
USA/Austria

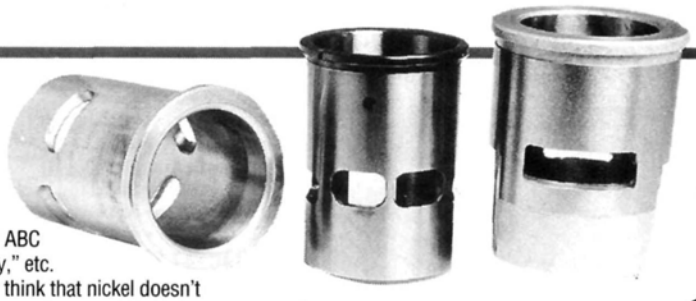
As the Needle Turns

Almost 80 percent of the engines listed use either air-bleed or twin-needle carburetors. The twin-needle carb, such as the new Enya S4040 pictured (below left), controls the low-end mixture with ar adjustable secondary needle valve. As the throttle barrel is closed, it also moves laterally toward the spraybar, bringing with it the seconda needle that gradually enters the spraybar orifice; this leans the low-en mixture.

Conversely, the air-bleed type, such as the new Fox Ultra E-Z carb also pictured, leans the low-end mixture not by reducing the fuel, but by increasing the air! Some modelers think that the twin needle provides more accurate control of the leaning process, giving slightly faster throttle response. We concur, noting that the adjustment of TN-type carburetors is more critical than that of air-bleed types. With air-bleed types, a the throttle barrel is closed, the air-bleed hole (which is visible on the front of the carburetor's body) opens to the inside of the venturi. Although air-bleed types often go a bit rich in the mid range, slowing throttle response, they also have slightly less fuel draw at lower throtti settings. This is because they are, in essence, leaking air when the a bleed passage opens to the venturi. They are, however, almost idiot-proof when it comes to adjusting. As long as you get the high needle setting right, most of the time, they're right on out of the box!

Probably the most interesting thing about this entire subject is that the last 25 years, Enya has resisted using anything but their air-bleed G-type carb. During this period, Fox used only butterfly valve, automo tive-style carbs, finally moving to their MX twin-needle carb more thai 10 years ago. It's ironic that at approximately the same time, the two companies swapped carburetor philosophies. They do, however, still offer the old carbs as options. I guess all of this goes to prove that bo systems work well. Once again, it's a matter of preference.

Knowing Your ABC's



Although the term ABC (aluminum, brass, chrome) has become well-known among model engine users and lovers, it's also a term that has been loosely applied to what are, in fact, other metal combinations. Pictured are three sleeves, all of which are used with aluminum pistons. A true ABC (left) is a brass sleeve that's plated only on the inside with chrome. Even with a honed-matte finish, under bright light, the chrome plating has a look all its own—unmistakably silver-white. To the best of my knowledge, all true ABC sleeves are chromed only on the inside, and the dark-gold brass is easily visible when you look through the exhaust port or between the head and the case where the sleeve flange sits.

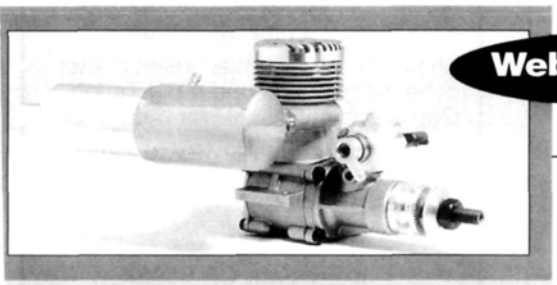
A brass sleeve that's plated with nickel is in the center. Although the nickel-plated sleeve is shiny, it looks dingy by comparison with the chrome—almost like pewter. Every nickel-plated sleeve we've seen is also plated on the outside (unlike chrome-plated sleeves). Why some manufacturers use nickel instead of chrome is simple: it's cheaper and easier to apply. In all fairness, it's worth mentioning that environmental concerns do exist when working with chrome.

How can engine makers call an engine ABC when, in fact, it isn't? Well, they often don't; they call it ABC "type," ABC "design," or ABC "technology," etc.

Although some modelers think that nickel doesn't last as long as chrome, until there's enough data for a full investigation and subsequent article, we aren't yet prepared to take a stand. At this point, we're not saying that nickel is inferior to chrome; we're simply saying that nickel is not chrome. The important thing is that you know exactly what you're buying.

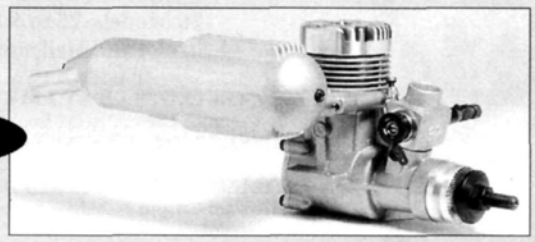
The third combination is AAC (aluminum piston, with a chrome-plated cast-aluminum sleeve)—on the right. Engine makers who use this technology proudly mark their engine boxes accordingly because they, and others, strongly feel that it's the best combination of all. They contend that an aluminum sleeve in an aluminum case has optimum heat-transfer and expansion characteristics. The problem? It's more difficult to plate chrome to aluminum than it is to brass; therefore, the process is somewhat more costly.

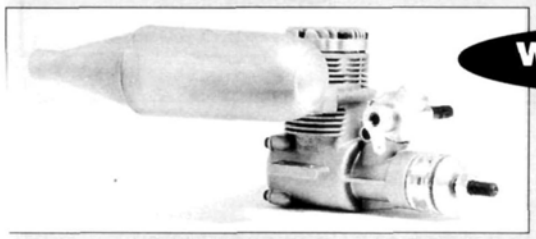
The last combination worth mentioning is a lapped iron piston with a steel sleeve (not pictured). This combo is used on less expensive sport engines and, if the engine is broken in properly, it does hold up well. It's easy to confuse a steel sleeve with a nickel-plated brass one. Most manufacturers using this technology accurately state the piston/sleeve materials in the included literature, if not on the outside of the box. If you're still in doubt, get a magnet!



Webra Silver Line
Austria

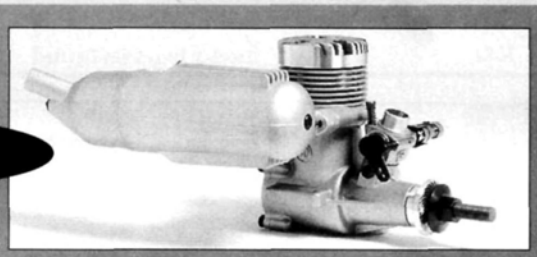
O.S. SF
Japan

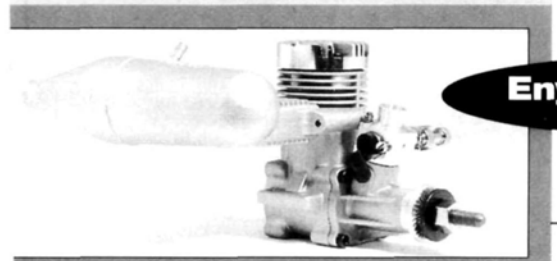




Webra Speed
Austria

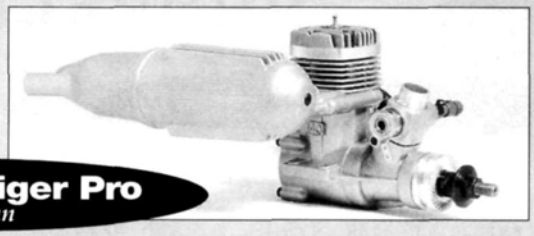
OSFP
Italy



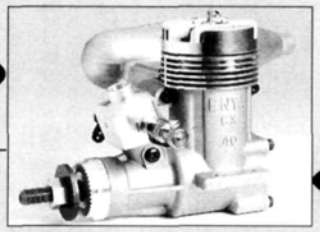


Enya SS Bushing
Japan

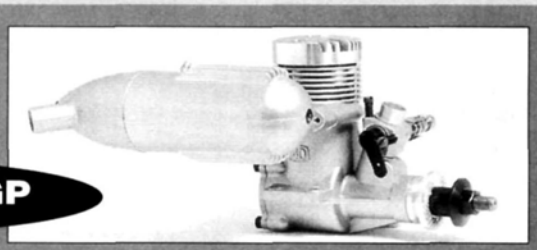
Thunder Tiger Pro
Taiwan

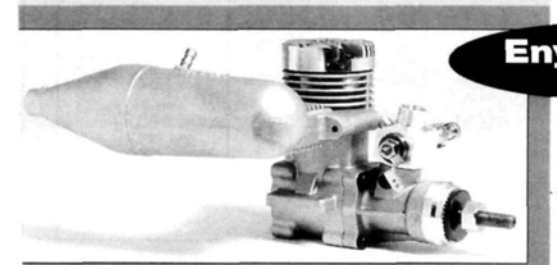


Enya CX
Japan



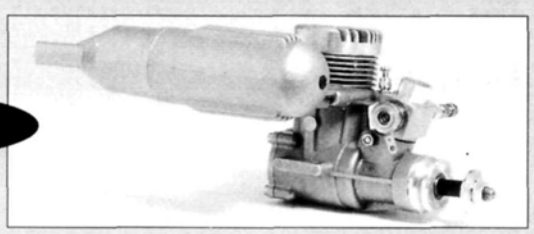
Thunder Tiger GP
Taiwan





Enya SS BB
Japan

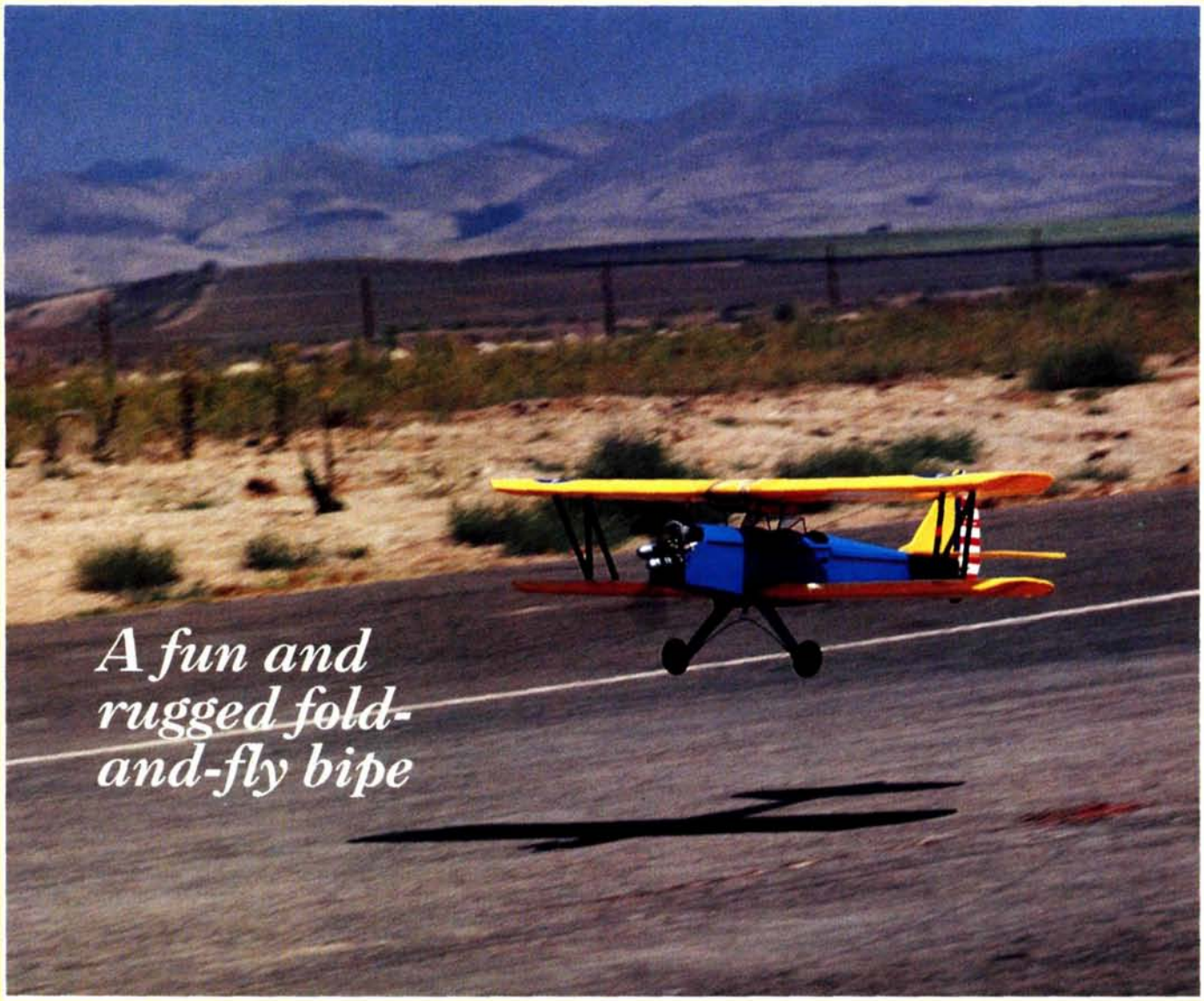
Royal
Taiwan



MODEL AIRPLANE NEWS MAGAZINE
FIELD & BENCH REVIEW

A "BARNSTORMER" is a pilot who travels from town to town performing aerobatic, circus-style demonstrations. The U.S. AirCore Barnstormer—the first biplane in AirCore's well-known fleet of "fold-and-fly" models—also loves to perform. The vibrant, fuelproof, Stearman-like design and the distinctively round fuselage top make the Barnstormer the most realistic of all the AirCore planes.*

PHOTOS BY ELAINE JACKSON



U.S. AIRCORE BARNSTORMER

by ELAINE JACKSON

FLIGHT PERFORMANCE

Our club's flight instructor, Ron Fiedler, was the test pilot. Ron is strictly a sport flier; as an instructor, he flies a wide variety of sport airplanes. Ron thought that the Barnstormer was an enjoyable airplane to fly, and he was able to perform all the basic aerobatics with it. The sport version of the Barnstormer flew equally well, although it flew faster and did all the maneuvers much more quickly.

• Takeoff and landing

Initially, we had problems getting the Barnstormer to take off as it tended to ground loop. We widened the landing-gear stance and reinforced the gear to make it stiffer. It's essential that you mount the landing gear as far back as possible. We eventually installed the landing gear backward with good results. With these minor modifications, the Barnstormer performed normal takeoffs. Be sure you have adequate right thrust when you install the engine. The Barnstormer needs plenty of power to take off; and be sure to get the tail wheel off the ground as quickly as possible. We also reduced the recommended rudder throw.

The Barnstormer has a fast rate of descent when it comes in for a landing. When you make a landing approach, don't cut the power too soon. A crosswind takeoff and landing didn't present any special problems.

• High-speed handling

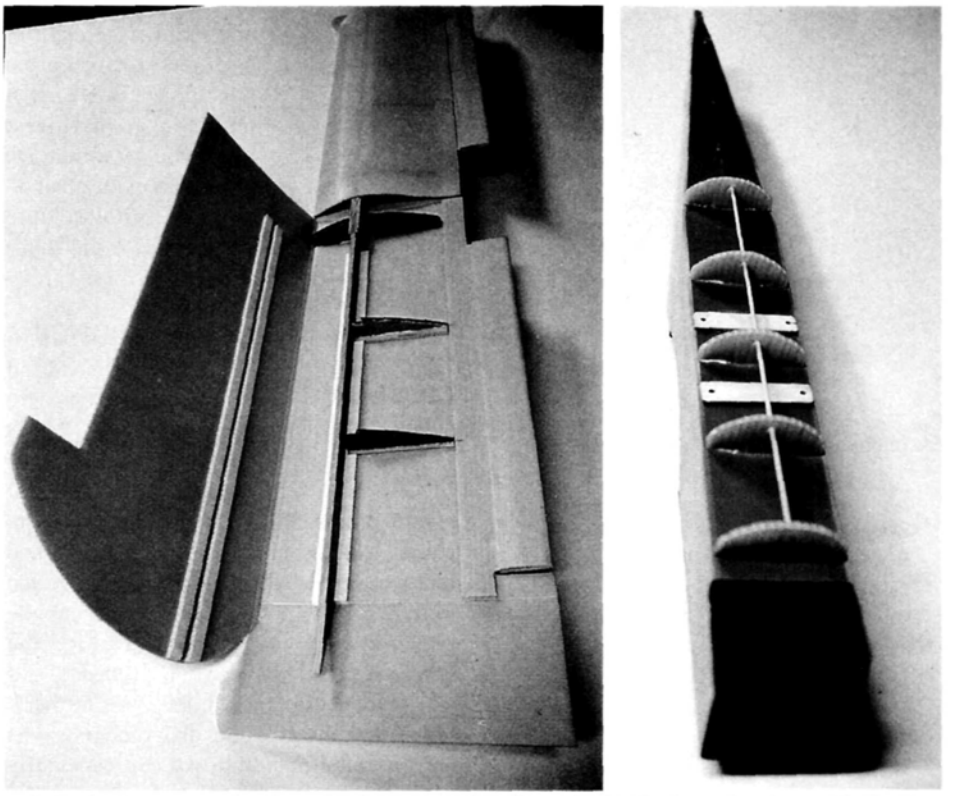
The Barnstormer is responsive on both elevator and aileron. It won't do a high-speed stall at the recommended settings, but if you increase the recommended elevator setting, it will do a high-speed stall when you do tight pylon turns, full deflection loops, or a pull-out from a split-S.

• Slow-speed handling

The Barnstormer is very stable in slow flight. Before a stall or full-elevator deflection at the recommended setting, the ailerons lose effectiveness; the airplane is best guided with small "blips" of rudder. If you use higher elevator settings, the nose tends to drop rapidly when the airplane does stall, and throttle needs to be added to regain flying speed to prevent loss of altitude for stall recovery. The airplane doesn't have a tendency to tip-stall.

• Aerobatics

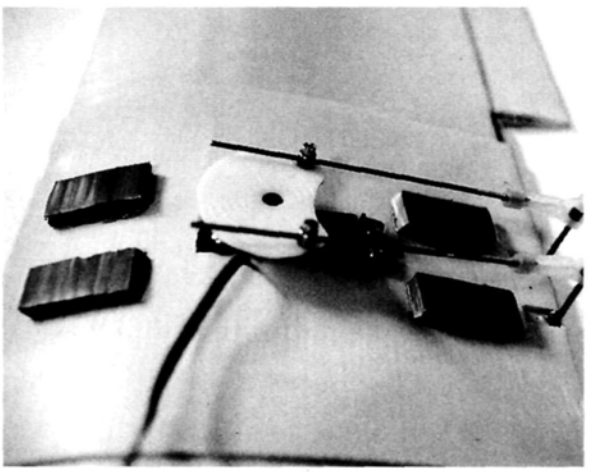
The standard Barnstormer will perform basic aerobatic loops, rolls, snap rolls, spins, stall turns and wingovers. To fly it inverted, you must hold a lot of down-elevator. This is a characteristic of most airplanes that have flat-bottom airfoils. This also makes it very difficult to do an outside loop. The short-wing version does aerobatic maneuvers much more quickly.



• Left: the Barnstormer's wing with the two partial ribs. • Right: the inner fuselage with the five bulkheads installed.

After they had crashed several models while learning to fly, Lawrence Ragan and George Barker, owners of U.S. AirCore, decided that there had to be a better way. U.S. AirCore technology was their answer. Simply put, AirCore is a tough, durable, corrugated plastic that can withstand a lot of abuse. AirCore planes come in various colors, and they don't require painting. They all use a power cartridge (PC) that houses the engine, the fuel tank, the battery, the servos and the receiver. The PC simply slides out of one AirCore plane and into another.

I became an enthusiastic supporter of AirCore airplanes at the 1990 Chicago Hobby Show. I worked in a magazine booth directly across from the AirCore display, and for four days, I watched people jump on an AirCore wing to demonstrate its strength and durability. When my husband, Les, and I were offered the chance to review the Barnstormer, we knew that it would be a very rugged model.

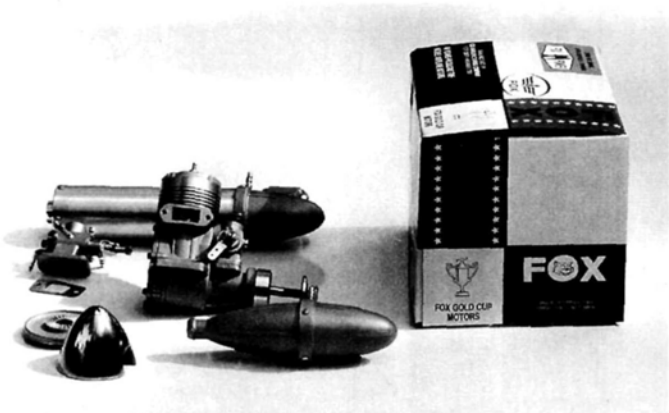


By placing the aileron pushrods on the servo wheel as shown, aileron differential is achieved without complicated linkage. The blocks are for securing and aligning the fuselage with the wing.

THE KIT

The kit comes with everything except the wheels and the throttle linkage. All the included hardware is of good quality and is made in the U.S. The Barnstormer can be built as a 50-inch-span (top wing) standard Stearman that has slow, docile, flight characteristics or as a 46-inch-span (top wing) sport version that's lively and more aerobatic. An imitation radial engine that you assemble out of AirCore® is also included. AirCore offers a separate wing kit for those who would like both wing sets. The detailed instruction manual is easy to read and has photographs and drawings. It also describes how to shorten the wings for the sport version.

The Barnstormer has a lot more pieces that require cutting than other AirCore kits. Use a good-quality pizza cutter to score



The Fox .50 engine runs well and is reliable. Using the Super Quiet Fox muffler, the noise measured 85dB.

SPECIFICATIONS

Model name: Barnstormer
Type: biplane
Manufacturer: U.S. AirCore
List price: $169.95
Wingspan: top wing—50 in., bottom wing—48 in. (standard); top wing—46 in., bottom wing—44 in. (sport)
Wing area: 882 sq. in.
Weight: 6.5 lb.
Wing loading: 16.97 oz./sq. ft.
Airfoil type: flat-bottom
Length: 36 in.
Engine rec'd: .40 to .50 2-stroke; .48 to .50 4-stroke
Engine used: Fox .50 with Super Quiet muffler
Props used: 10x7 and 11x6 Master Airscrew
No. of channels req'd: 4 (throttle, aileron, rudder and elevator)
Kit construction: AirCore® material

HITS
- Strong and durable.
- Easy to build.
- Doesn't require painting or covering.

MISSES
It was difficult to build a perfectly straight wing owing to the flexibility of the AirCore® material. (This didn't affect the plane's flying capability.)

the creases for folding, and number or identify each piece. If you use a felt-tip pen, don't use it near the open flutes; when you try to remove the marks with alcohol, the ink/alcohol mixture will seep into the flutes and make a mess.

CONSTRUCTION

Except for the added cabane struts, the Barnstormer's PC is basically the same as those of other AirCore planes. You can still use it in other AirCore planes by loosening the wheel collars and removing the struts before you remove the unit. Using wheel collars on the cabane struts allows you to easily change the wing's level and incidence if needed.

Another difference in the Barnstormer's PC is that the elevator and rudder servos are mounted upside-down. Be especially careful when you drill the holes through the PC for the cabane struts. We used a small square and sighted the drill and the square while drilling the holes. Use a Dremel tool to round the ends of the cabane wires so they go in and out more easily.

FUSELAGE

The Barnstormer consists of an inner fuselage that's built first and later enclosed by an outer skin to give the model a more realistic, round fuselage compared with the box-like fuselages of other AirCore models.

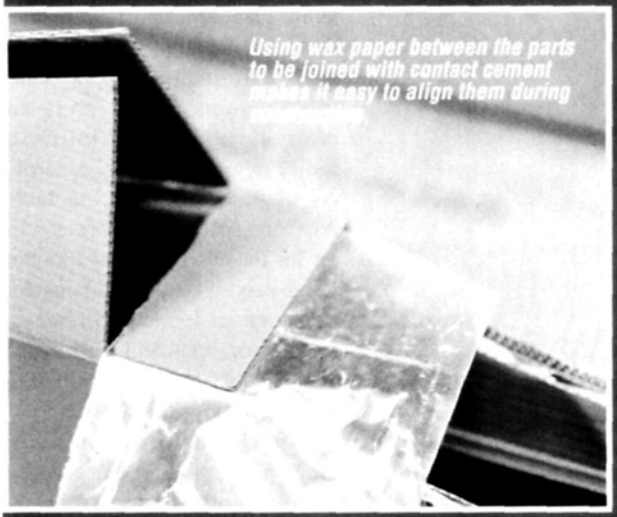
To assemble the inner fuselage, first glue in the main fuselage doublers. The manufacturer advises against using water-based contact glue. They recommend Bob Smith Industries* "Instacure Plus." It's important to follow the directions and trial-fit the pieces first. Drill holes in the rails (along with the PC) to properly fit the cabane wires. Then install the rails and the rail doublers, and fit and glue the wing-saddle doublers into place.

Installing the cabane alignment brace was a little difficult because the cabane wires must go through the flutes and align with the holes that have been drilled in the PC. The main fuselage bulkhead is notched and fitted into place. To finish the inner fuselage, follow the fold-up steps in the instructions carefully. Then assemble the cabane platform.

The fuselage is next. In order to form its rounded appearance, install five half-rounded bulkheads on top of the inner fuselage. The instructions tell you that these bulkheads don't have to be glued, but we used Zap-A-Dap-A-Goo* to stick them into place. To make the seam less visible, take special care to trim and fit the outer skin. To seal the seam, we used a GE auto gasket (blue silicone RTV) that almost matches the Barnstormer's blue fuselage. If you want to hide the seam, use red pinstripe tape.

The Barnstormer's double cockpit and windshields finished off the fuselage. The instructions tell you to miter the corners when you install the cockpit coaming. Although it was a lot more work, we installed the coaming in one piece, using masking tape as a hold-down and a ruler to help bend the windshield along the lines. Make sure the lines are on the outside of the windshield.

The Barnstormer comes with a characteristic simulated radial engine made of black AirCore® material. To simulate the pushrods, we used silver pinstripe tape



Working with Contact Glue

A few modelers are intimidated by the use of contact glue in model building. Because this is the third AirCore plane my husband and I have built, we've developed a simple method for using it.

When the contact glue is no longer tacky, put a piece of wax paper on one of the pieces to be glued together about an ⅛ inch from the top edge of the piece. When the pieces are perfectly aligned, press the ⅛-inch edge down firmly to tack your work in place. This also acts as a hinge, so you can gently lift the top piece, remove the wax paper and finish pressing down the top section.

It *is* possible to separate pieces that have been glued together with contact glue after the glue has dried. You'll need a plastic putty knife or a table knife and lacquer thinner. It's important to keep the knife and the area you're trying to separate moistened with lacquer thinner. A small paintbrush is helpful. Be careful not to get thinner on the decorated or painted areas; it will ruin them. Make sure to remove all the old glue before re-gluing.

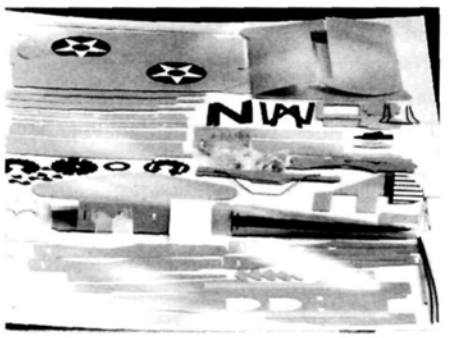
The Barnstormer isn't a trainer or a precision aerobatic airplane; it's an easy-to-build, enjoyable-to-fly airplane for sport fliers who want a durable, inexpensive biplane.

instead of the recommended silver-painted toothpicks.

WINGS

The Barnstormer's detachable upper ailerons are unique. If you prefer tamer flight characteristics, you can fly with only the lower ailerons.

The wings take less time to build than the fuselage. First you must glue down the spar-alignment strips. You can use the actual wooden spar to help line the strips up before gluing. It's critical that the spar is aligned perfectly for the final wing clos-



The Barnstormer straight out of the box.

ing. The instructions call for each wing to have two AirCore® ribs installed near the root. Although it isn't necessary, we added two partial ribs made of scrap AirCore®; we thought they might help to keep the bottom airfoil flat. The ribs were installed 6 inches apart behind the wing spar extending to the trailing edge.

Before the wing is closed, the leading edge must be bent, or "exercised" properly. Apply glue to the wooden spar and the trailing edge, then cover the glued area on the trailing edge with wax paper. This allows the spar to be fit properly without being mismatched when brought together. After the wing has been closed, wrap the center of it with the 2-mil AirCore® wing wrap to increase strength, and add 1/16-inch music wire for reinforcement. It's easier to measure and install the music wire before applying the wing wrap.

ENGINE

My husband and I disagreed on which engine to use. (Even best flying buddies don't agree on everything!) Because of the radial engine, the guys at AirCore recomended a 4-stroke (preferably a Saito* .50) to swing a good-size prop. My husband thought that a plane called the U.S. AirCore Barnstormer should have an American-made engine, such as the Fox* .50 2-stroke. I agreed with his choice.

We followed the manufacturer's instructions for breaking in the engine. The Fox .50 ran extremely well with plenty of power, and it idled well. We also used the Fox Super Quiet muffler, and the assembly checked out at an impressive 85dB. Because of its size and weight, we had to brace the muffler as if it were a tuned pipe. The Fox .50 has a wide crankcase, so we had to modify the engine mount to make it fit properly. Unfortunately, we had to remove the dummy radial engine and use a 11x6 Master Airscrew* prop. Although the dummy radial engine looks neat, it caused the engine to run too hot with a definite power loss. One of our friends had the same problem with a powerful .45, and he ended up taking the radial engine off, too. If the radial engine is important to you, it might be better to stick with a 4-stroke.

FINAL ASSEMBLY

First install the tank, the radio equipment and the engine in the PC unit. We used a JR* PCM 10 heli radio and standard servos in our model. Then slide the PC unit into the fuselage through the open area at the nose. The cabane assembly is installed in the fuselage. Lock the PC unit in place by slipping 5/32-inch wheel collars onto the cabane wires. Use rubber bands to attach the top wing to the cabane framework and the bottom wing to the fuselage. The wing interplane struts are made of AirCore® and have 1/16-inch-diameter music wire slipped through the fluted material. The wire ends are pushed through holes in pads that are glued to the top and bottom wings.

CONCLUSION

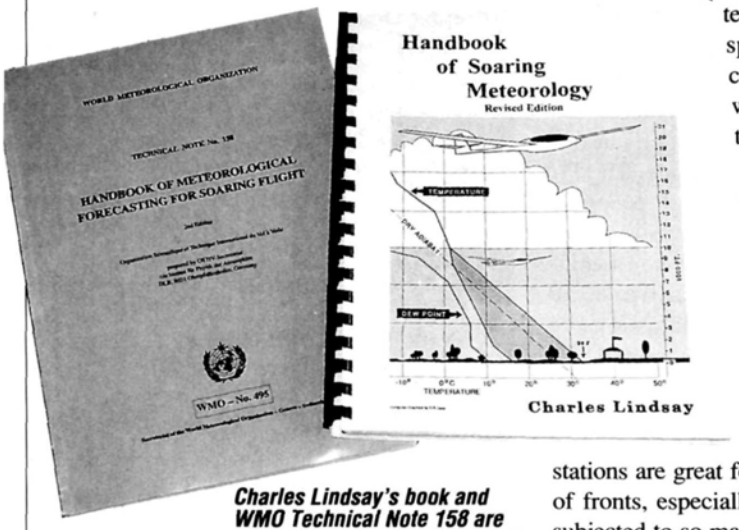
The Barnstormer isn't a trainer or a precision aerobatic airplane; it's an easy-to-build, enjoyable-to-fly airplane for sport fliers who want a durable, inexpensive biplane.

**Addresses are listed in the Index of Manufacturers (for page number, see table of contents).* ■

CENTER ON LIFT

MICHAEL LACHOWSKI

BASSWOOD AND FORECASTING



Charles Lindsay's book and WMO Technical Note 158 are just what sailplane pilots need.

ON THE EAST Coast, the winter was a flier's nightmare, but I did plenty of building while looking out at the horrible weather, so I had a lot of time to consider building materials. Cellulose composite (normal folks call it wood) comes in plenty of varieties, of which basswood is frequently overlooked. I find it very useful, and I'll discuss a number of its sailplane applications.

After a model has been built, it's time to fly. I'll give you a few resources you can use to find out whether it will be a pleasant day at the field. Armed with a more detailed understanding of meteorology, you'll know which kinds of thermal activity to expect.

HOW TO WEATHER THE WEATHER

After learning to fly, we all spend years learning about how the weather affects our soaring. Up-to-the-minute local weather forecasts are invaluable, as are the U.S. Government National Weather Service reports. You can tune in to these with one of the inexpensive weather radios you can find at Radio Shack. These radios receive the three frequencies allocated to weather information around the country. The key broadcast information includes predictions of high and low temperatures, weather patterns (or fronts) and wind speed. (Anyone know a cheap way to get the weather channel out at the field?)

Most areas pick up only one station. I'm in the Northeast, and I receive two stations on two of the frequencies. Depending on where I am and on my antenna orientation, I can get two additional forecast offices. The extra stations are great for checking the progress of fronts, especially in this area, which is subjected to so many storm tracks. At contests, the radio is always with me. If the weather is changeable, it's a great resource, and knowing temperature differentials, humidity and cloud cover helps me to estimate the strength of thermal activity.

With the right equipment, it's easy to track changes in the local pressure and temperature. In the March '94 issue, I talked about the Avocet Veritech watch. After zeroing the pressure-change information in the morning, you can track pressure changes through the day. If you keep the watch where it can give you good temperature readings, you have a portable thermometer (too bad it doesn't give humidity readings).

Unfortunately, it's harder to get the ultimate in soaring forecast information—upper air soundings. These soundings are done twice a day at many places around the country. The data includes wind speed, direction, pressure, temperature and dew

Basswood—an alternative to plywood and hard balsa

Many builders ignore basswood, but it's useful anywhere you need wood that's harder than balsa. Basswood is harder than most balsa, not as stiff as plywood and easier to carve without splitting than spruce. It's light—about 26 pounds per cubic foot, which is slightly lighter than spruce.

Basswood's soft texture makes it easy to work; it has a nice, straight grain; and it's easy to carve and plane. It's more ding-resistant than balsa. When used with obechi, it's easy to sand because it more closely approximates the hardness of obechi than balsa. You may have encountered basswood in some kits; it's primarily used for leading edges. Since you don't have to worry about undercutting a basswood leading edge when it's butted against obechi, you get a better airfoil than when using balsa.

Wing joiners are a good place to use basswood. Many models use plywood for the reinforcement of dihedral and polyhedral joints. The problem with plywood is that it's very stiff compared with the spar material. The basswood will be able to bend with the rest of the wing and reduce the stress concentrations that usually occur at the end of plywood reinforcements.

In fuselages, basswood has a multitude of uses. Use a block of basswood instead of plywood for a bolt mount and for a screw-attachment point in a hatch mount. Use a thicker piece of basswood to increase a gluing area without significantly increasing weight. Since it's easy to carve, it's perfect for a nose block.

Next time you need a wood that's harder than balsa, give basswood a try. If your hobby shop doesn't stock it, you can buy sheets and strips from Lone Star Models*.

ON THE NET

Air Age Publishing is now connected to the Internet, and so am I, so those of you who have ventured into the world of electronic communications can send me electronic mail. If you have interesting information or if there are topics you would like me to cover, my address is mikel@airage.com. If you're on Compuserve, AOL, or some other network, chances are that you can send mail to this address, too.

Club newsletters are welcome, too. I currently get a good collection of newsletters as part of my newsletter exchanges for the Eastern Soaring League newsletter, which I edit. I always enjoy reading club newsletters. We have much in common across the country, including a desire to generate more interest in soaring and establish pilot proficiency categories. One area of increased interest is hand-launching; man-on-man scoring in competition is increasingly common, too. If you want to add me to your mailing list, my snail-mail address is 253 Bloomsbury-Pittstown Rd., Milford, NJ 08848.

point at many altitudes. With this information, you can predict the strength of thermals and how high they will rise, thereby obtaining a "Thermal Index." I'll talk about this information in another column.

Forecasting is challenging. Most of the forecast information we get is general, and there's nothing specific to soaring. You have to learn how to do it yourself, and I recommend these two excellent reference books:

■ Handbook of Soaring Meteorology, Revised Edition

This book by Charles Lindsay is a good starting point. The first six chapters get you up to speed on basic meteorology and jargon. You're sure to develop a better understanding of how the atmosphere works, especially how it affects soaring. It explains atmospheric conditions, such as inversions, and tells which air masses offer the best conditions for good soaring. There are chapters on: reading weather charts; forecasting (several chapters are devoted to forecasting for different types of full-scale soaring); and obtaining the information you need to do your own forecast. Part II is devoted to soaring meteorology: cross-county, hill and sea breeze soaring; forecasting thermals; and weather support for contests.

- *Available from Charles V. Lindsay, 1030 Colonial Meadows Way, Virginia Beach, VA 23454.*
- *Price—$21.95.*

■ World Meteorological Organization Technical Note 158, Handbook of Meteorological Forecasting for Soaring Flight

The information in this second work is organized differently from that in the first, so the works complement each other. This reference book does an excellent job of summarizing soaring meteorological forecasting techniques. There are chapters on: gliding; forecasting thermals, mountain waves and thermal waves; forecasting for slope soaring and outstanding soaring flights; and a section on useful conversion formulas.

- *Available from: the American Meteorological Society, 45 Beacon St., Boston, MA 02108; attention: Publications Order.*
- *Price—$28 (plus $5 S&H).*

Thermal pilots might think that slope pilots just heave the sailplane and fly, but there are signs to read at the slope, too. The water's surface actually tells you a lot about the winds: wave height varies with wind strength, and you can actually detect the presence of wind fronts, gusts and thermals over the water by the signs on its surface—differences in the wave patterns. If you want to dig up this information, wander over to the sailing section at the library or bookstore, or let me know what you're looking for, and I'll do my best to help.

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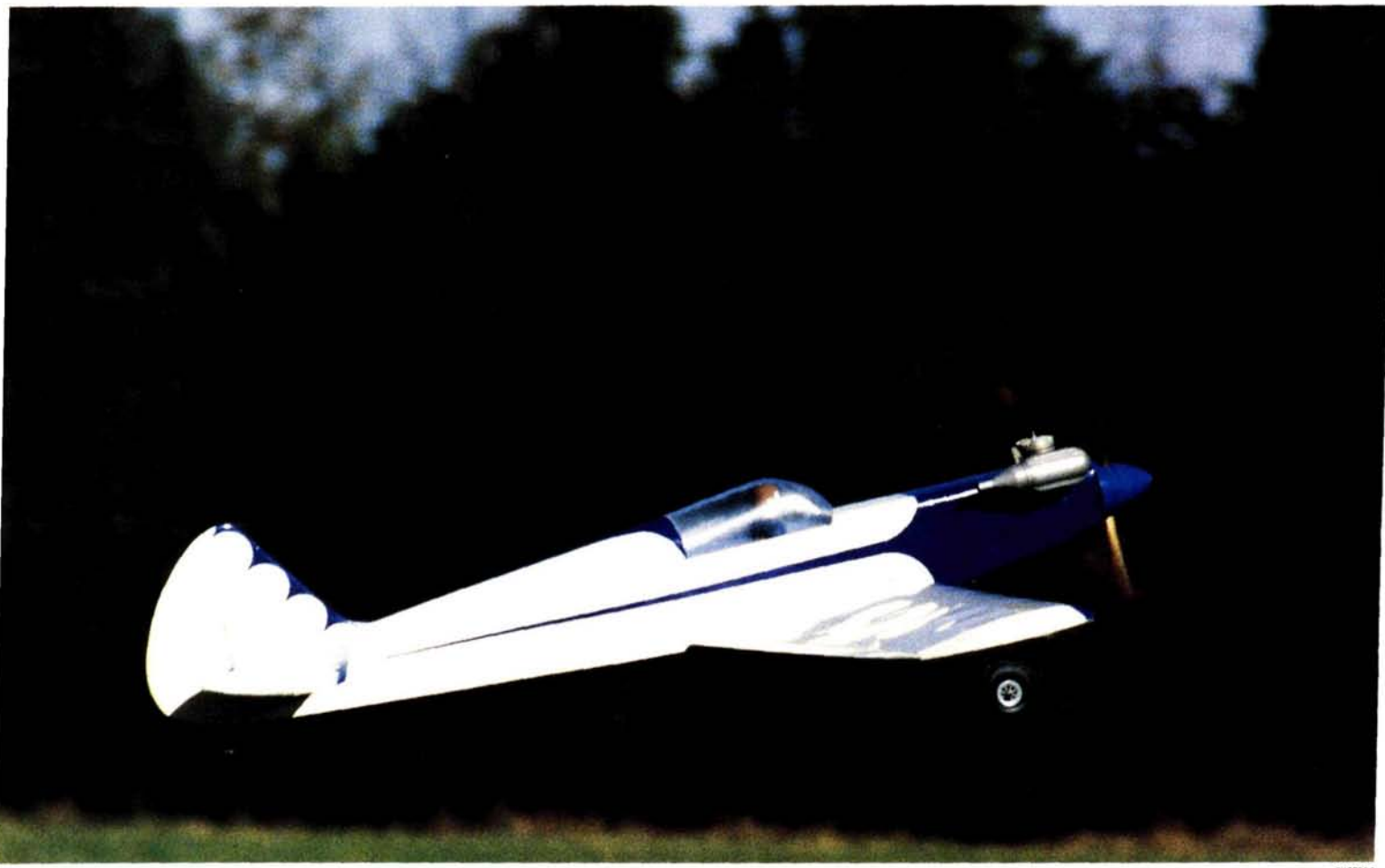
MODEL AIRPLANE NEWS
FIELD & BENCH REVIEW

The next model to fly after the Telemaster!



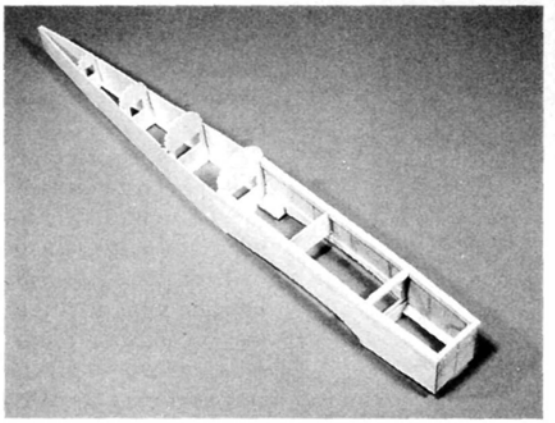
PHOTOS b

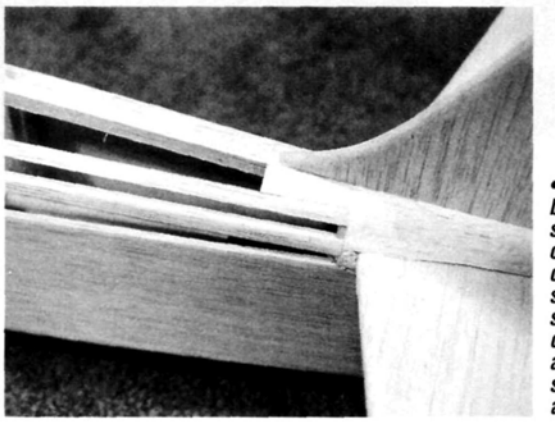
HOBBY LOBBY Telesport

by RON FARKAS

THE TELESPORT IS a fairly recent addition to Hobby Lobby's* line of domestically produced airplane kits. It falls into the very popular category of low-wing, sport, aerobatic models in the .40 to .61 engine-displacement range. Rather than having a constant-chord configuration, the Telesport has an attractive double-tapered wing. It resembles a single-seat homebuilt aircraft.

Some years ago, the original high-wing Telemaster was one of the most popular trainers. Hobby Lobby advertises the Telesport as a logical next step after you've become proficient with a Telemaster. I would support this claim for the low-wing Telesport, since it's nearly as well-mannered as an aileron trainer, but with considerably more aerobatic potential. Like its predecessor, the Telesport combines good aerodynamic principles with good looks and relatively simple construction.



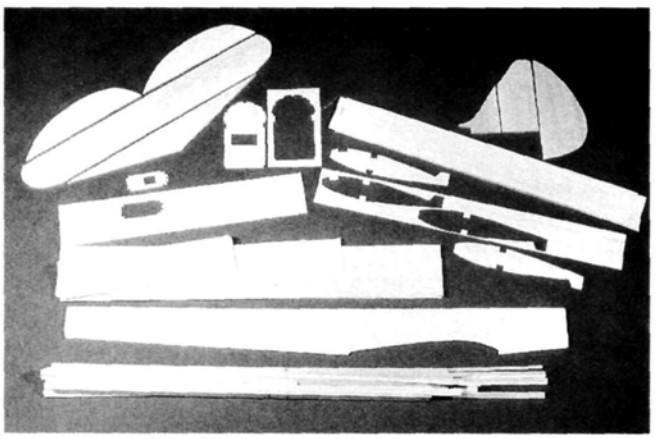


• Far Left: the fuselage construction begins as the standard box and consists of sides and formers. The sturdy construction features internal vertical-grain doublers and longitudinal stringers. • Left: the fin and stabilizer are faired into the fuselage contour with soft blocks. The author added scrap fillets between the stringers for better covering attachment.

Although the structure is simple to build, there are a few places where the builder must improvise to complete a step. The situation is aggravated by the brevity of the instructions, but the photos are good. Some of the wood in the review kit—particularly for the tail section—was heavy, but still usable. On balance, these flaws are greatly outweighed by the Telesport's outstanding flying characteristics.

KIT CONTENTS

The kit includes machine-cut fuselage sides, die-cut formers, die-cut wing ribs, machine-cut sheet tail surfaces and an assortment of sheets, strips and blocks. Hardware consists of formed wire main landing gear, aileron torque rods, elevator joiner wire, a tail-gear bearing bracket, nylon wing-mounting bolts and T-nuts, hinges, horns and threaded rods. A vacuum-formed canopy is also provided. Two rolled plan sheets show the wings separate from the fuselage. The plans are easy to understand. The instructions include a materials list and sketches of the die-cut parts sheets.



Kit contents show the selection of sheet and die-cut parts. The balsa and light plywood die-cutting are very clean.

The Telesport has a conventional built-up balsa airframe. I used Carl Goldberg Models* Jet CA, i.e., Super Jet for most of the building, regular Jet for tacking the components and Slow Jet with Jet Set accelerator for the fillets.

THE WINGS

I built the wings first. To aid in the construction of the fully symmetrical airfoil tapered wing, the ribs have alignment tabs that rest on the flat building board. The left panel is built first, and it includes the main dihedral braces. First, glue the two 1/16-inch plywood braces to the front and rear faces of the bottom main spar, and place the assembly over the plan. Two of the ribs are prepared by attaching the balsa landing-gear doublers. Now is a good time to trim the ribs so that the landing-gear blocks will fit well.

After the ribs have been glued to the bottom spar, add the top spar, followed by the leading- and trailing-edge stock. I had to true the front and rear of the ribs with a long T-bar sanding tool so that the leading and trailing edges would fit well. Before sheeting, remove this panel from the board, and cut the alignment tabs off the bottom

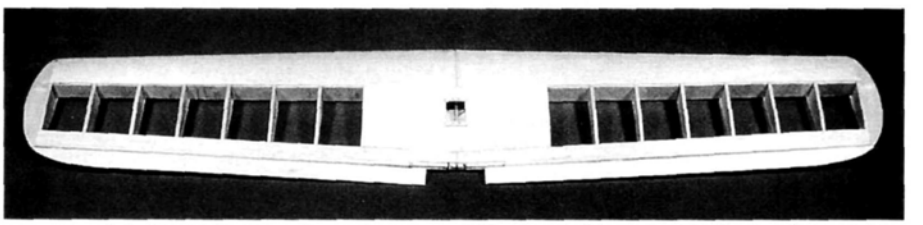
SPECIFICATIONS

Model name: Telesport
Type: low-wing sport aerobatic
Manufacturer: Hobby Lobby Intl.
Price: $88.90
Wingspan: 60 in.
Wing area: 639 sq. in.
Weight: 5 lb., 13 oz. (advertised as 6 lb.)
Wing loading: 22 oz. per sq. ft.
Length: 45 in.
Rec'd. engine: .40 to .61 2-stroke
Engine used: K&B .61
No. of channels req'd.: 4 (throttle, elevator, rudder, aileron)

Features: conventional balsa and light plywood built-up construction; rib-and-spar wing with D-tube sheeting and capstrips; fully symmetrical airfoil with building tabs on the ribs; sheet fuselage sides and turtle deck enclosed by stringers; wide-stance, wing-mounted main landing gear with tail wheel; complete hardware package; canopy and decals.

Hits
- Quick construction.
- Great flying characteristics.

Misses
- Instructions are on the brief side.
- Some of the balsa is too hard.
- No molded cut lines on canopy.



The completed wing is very strong because of the ample 3/32-inch sheeting and capstrips. Plywood dihedral braces are in front of and behind the main spars.

FLIGHT PERFORMANCE

• Takeoff and landing

The wide stance of the main landing gear makes ground handling a pleasure, and there's plenty of prop clearance if the field is rough. Ground loops (sometimes a characteristic of tail-draggers) aren't a problem. Just the usual right rudder is required for straight takeoffs. Owing to the moderate wing loading, there's very little risk of a stall or snap during takeoff. The climb-out is steady and straight.

The model handles very well in the traffic pattern. In a rectangular approach, nice square corners can be accomplished, and the Telesport tracks well, even at low throttle settings. The controls remain effective right to touchdown, and the model can easily be "crabbed" to counteract a crosswind on final. Because it's a clean airframe, the air speed doesn't fall off immediately after you cut the engine to idle. Therefore, it takes some planning to perform a classic full-stall three-point landing, although the slightly faster main-gear landing is just as satisfying.

• Low-speed performance

The Telesport is quite well-mannered at low air speed. Its thick airfoil and blunt leading edge probably contribute to its low stall speed. Control authority is good to the point of stall, and recovery is immediate. A normal stall is straight ahead with slight altitude loss. An accelerated stall, i.e., one brought on by a turning and banking attitude, may result in a moderate snap roll and some altitude loss. This situation is rare, and it happened to me only when I flew very slowly and close in for the cameraman. Otherwise, the Telesport provides a solid feeling of confidence at all times.

• High-speed performance

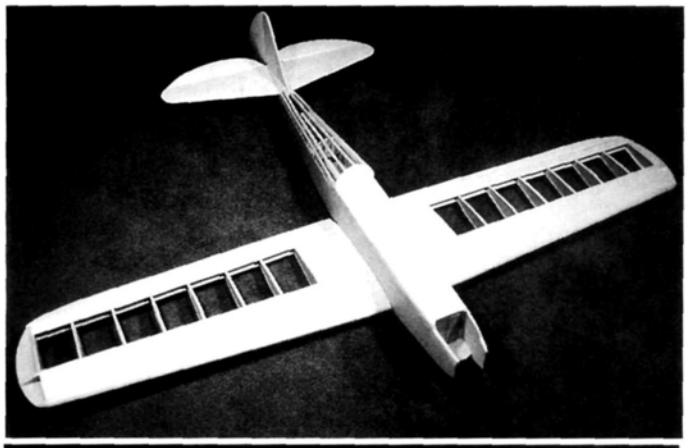
Although the chosen K&B .61* engine is at the top of the displacement range, it's about in the middle of the power range. It's more than adequate for all maneuvers including sustained vertical climb. A strong .40 would be adequate for sport flying, while a hot .60 would give a scalding performance.

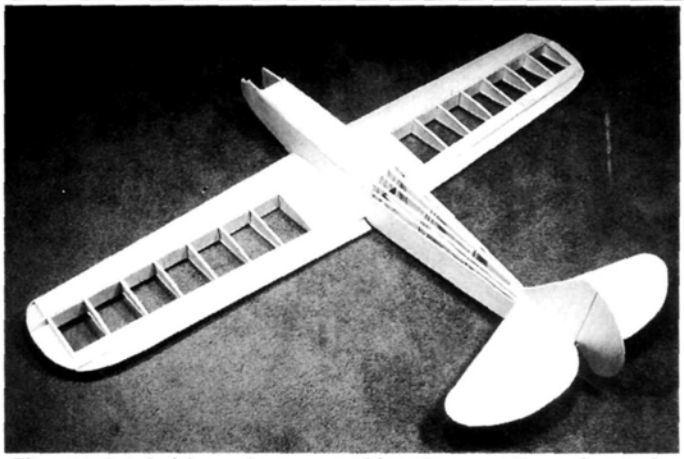
At cruise throttle settings and above, the Telesport tracks straight yet has quick reflexes for sport aerobatics. While experimenting with various control throws, I found that too much can cause a high-speed snap, while too little just softens the response and takes away all the fun. The throws shown on the plans have proven to be the best for all flight speeds.

• Aerobatics

The Telesport really shines at aerobatics. The kinds of maneuvers that sport pilots usually do—loops, rolls, snaps, spins and inverted flight—are all very easy to perform. The Telesport does not care what attitude you recover in; it just goes straight ahead when the controls are neutralized. It's a great deal of fun to fly this way, and it gives the average pilot the confidence to try new maneuvers.

The extra power of the top engine sizes also allows the Telesport to serve as a sport/pattern trainer. It could probably be flown in some of the lower competition pattern classes. The maneuvers can be stretched out for this form of aerobatics, and there's adequate vertical performance for the maneuvers that need it.





The completed airframe is strong and has the proportions of a single-seat homebuilt airplane.

of the ribs. Elevate the wingtip to the proper dihedral, and build the right wing panel onto the left one.

When the second panel has been completed, remove the wing from the board, and install the 3/32-inch balsa sheeting and capstrips. This sheeting process is somewhat awkward since the wing is no longer held in alignment, so care must be exercised to avoid warping. The completed wing is very strong.

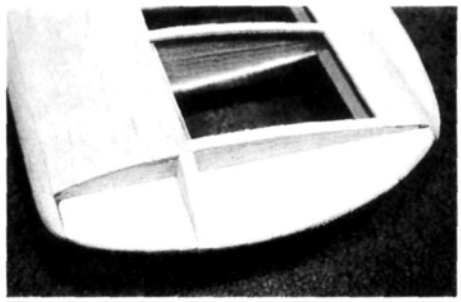
I did not care for the aileron torque rods that were provided. The plastic bearing has no mounting tab, nor is it captured by any part of the trailing-edge structure. I substituted a similar product by Du-Bro* that can be mounted on the trailing-edge stock using a tab.

FUSELAGE

Prepare the fuselage sides by installing the internal vertical-grain doublers (cut from 1/16-inch sheet balsa), the die-cut 3/32-inch balsa wing-saddle triplers and some strip stock. The three midsection formers are then glued to one fuselage side, followed by the addition of the other fuselage side. Just prior to this step, I relieved the former F-2 so that I could fit a 12-ounce fuel tank. Installation of the firewall and the aft formers completes the basic fuselage box.

While the fuselage was open on the top and the bottom, I fit the wing onto it. It's easy to drill through F-2 and into the wing to align the hole and the 5/16-inch leading-edge dowel. It's also easy to drill through the trailing edge and the hold-down blocks to allow for the mounting bolts. I discovered that my three servos had to be mounted lower in the fuselage than illustrated on the plans. I substituted a 5/16-inch hardwood dowel for the supplied 1/4-inch-square balsa pushrods, but I did use the supplied threaded pushrod ends. Once the pushrods were in place, I installed the aft top 3/16-inch-square balsa stringers.

Next, bolt a motor mount to the firewall,



The simple sheet-balsa wingtip uses gussets for reinforcement and to support the covering material. Ailerons are tapered and rounded to meet the tip contour.

and install the 1/4-inch sheet-balsa side nose blocks. Angle the blocks inward so that they just clear the mounting beams. Before you close up the nose, install the fuel-tank floor and the throttle pushrod. A single 1/2-inch-thick balsa block is provided for the top deck. To simulate the angle of an instrument panel, cut a bevel on the aft end. This block is barely long enough to fit the canopy, so be careful not to cut too much material off. After gluing on this block and the cross-grain sheet-balsa

cockpit floor, sand the fuselage to a smooth contour. Although it wasn't mentioned in the instructions, you'll have to fill a couple of openings in the side near the firewall with scrap stock.

The vacuum-formed canopy can be trimmed and trial-fit now. There are no lines molded into it to guide you. Trim the canopy carefully so that it will reach from the foredeck to the turtle-deck former and have about a 1/16-inch overlap for gluing. If you inadvertently trim too much, a quick fix would be to add a false former to the face of the existing one.

Now it's time for the tail surfaces. The elevator halves are joined by a piece of formed wire. Gluing, sanding and hinging are straightforward (the wood could have been of a lighter grade to save weight). The stabilizer-to-fuselage joint is reinforced with triangle stock, which is a good idea. The fin is faired into the fuselage contour with soft blocks carved to shape. Just beneath the fin's leading edge, I added some scrap balsa filler between the stringers to make the covering job easier.

FINAL ASSEMBLY

For finishing, I decided on the scalloped rim scheme that's shown on the box. I used Hobby Lobby's Oracover heat-shrink plastic film, which has always worked well for me. I cut the scallops with a circular template and ironed them on using a moderate temperature setting. The firewall and the inside of the cowl were painted with Hobbypoxy's* blue epoxy enamel, which matches the color of the heat-shrink plastic.

I used a Futaba* radio with four S148 servos. By using the .61-size engine and placing the airborne battery under the tank, right behind the firewall, the model balanced as shown on the plans. The completed weight, 5 pounds, 13 ounces, is 3 ounces under the target weight—a pleasant surprise.

SUMMARY

The Telesport's flight characteristics are predictable. Depending on the engine size and the amount of control throw, the plane can be tailored to suit different flying styles. Although some aspects of construction are less than ideal, the kit is a good buy. It is a thoroughly enjoyable model to fly, and it just does everything well.

Addresses are listed alphabetically in the Index of manufacturers (for page number, see table of contents). ■

AEROBATICS MADE EASY

DAVE PATRICK

TACKLING THE TORQUE ROLL

A BUNCH OF years ago, a young man named Charlie Hillard took his little Pitts Special and showed the world the first torque roll. He pulled up to a vertical attitude, stopped the aircraft and, at that point, with full power, the little Pitts hovered. It started to roll from the torque of the engine alone! Since the power-to-weight ratio didn't exceed one to one, the Pitts drifted backward at full power and was still rolling. Wow!

It amazed everyone, and I believe he went on to win the aerobatics world championships with his full-size Pitts. The torque roll certainly got everyone's attention then, and it still does today. A well-executed torque roll is very difficult in a full-size aircraft, but it's even more so in an R/C model! I'm not aware of the torque roll being covered by any articles to date, so this month, I thought it might be interesting, not only to go over what the maneuver is, but also to walk you through the execution of a torque roll.

It amazes everyone to see a perfectly executed torque roll. You'll need a lightweight model, big control surfaces with a lot of throw, an aft CG and a very reliable engine.

THE RIGHT STUFF

Having the right tool for the job is really important here. Even if you're just learning these maneuvers, if you don't have the right setup and the right aircraft, you'll just frustrate yourself. With that said, you'll need an aircraft that has very generous control surfaces and lots of throw. When your model is at the near-hovering position, there's very little airflow over the controls. There's no substitute for area, i.e., the use of large rudder and elevators, so, if you need to make any corrections, you'll still have some control. The model should also be light. "Light is right"; your overweight "whatchamacallit" will give you nothing but grief.

It's important to have a reliable engine. You'll be in a very awkward position if an engine quits at the wrong moment! Don't be satisfied until you're totally comfortable with your engine's reliability. (Not that you should be, anyway....) While we're on engines, one that has a lot of torque, such as a good 4-stroke, can really help.

I recommend the largest-diameter, lowest-pitch prop that you're comfortable with. Experimentation is the best way to determine what works best on your setup.

The CG plays a pretty big role here, too, and this can be a touchy area—pun intended! Torque rolls love an aft CG, but be very careful here—*very*. Remember, we already have a bunch of throw, and now we're asking for an aft CG. This can be a formula for disaster, so tread lightly, and make these adjustments in *small* increments! By the way, I really like using exponential on all controls to help reduce the touchiness of aircraft set up this way.

SET YOURSELF UP

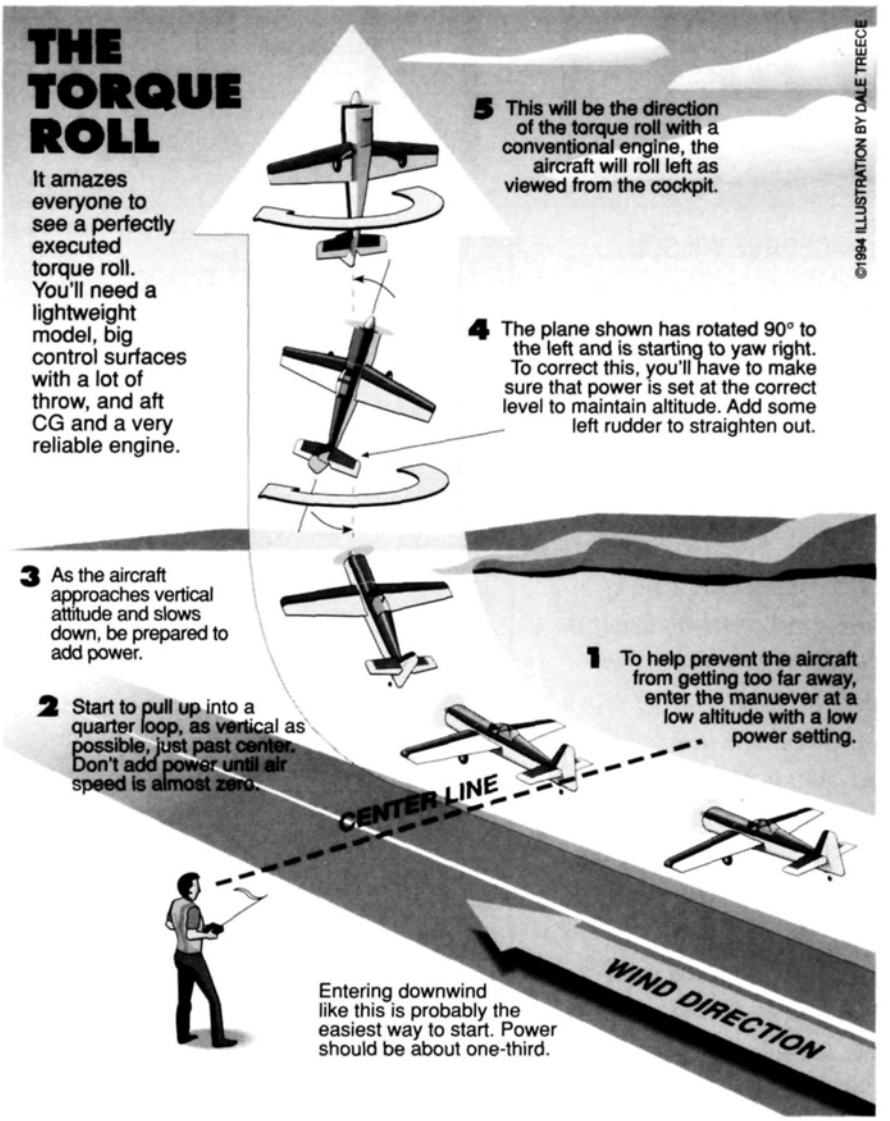
I've found the following setup provides the control authority that really helps to achieve successful torque rolls with a Goldberg* Sukhoi:

- a YS* 1.20 engine;
- an APC* 16x8 propeller;
- about 35 degrees of throw each way on the elevator and rudder;
- 25 degrees of throw each way on aileron (about 35 to 40 percent expo on each to soften the controls around neutral);
- CG location at 6 inches aft of the leading edge where it meets the fuselage.

This setup isn't for the faint-hearted, so don't start here; work your way to these numbers. We are near the point of inherent instability.

Now that your plane has been set up properly, let's try a few torque

rolls. Here are a couple of tips to start. First, try to start your first torque rolls with the plane as close to you as you're comfortable with. If you can't see the aircraft really well, it can drift off heading only a few degrees. Without the ability to recognize these slight deviations, you won't be able to compensate for them or recover correctly, and you'll end up "falling out" of the maneuver. Always start hovering so that the plane drifts away from you; it's safer and easier. By the way, it's not practical to compensate for the wind during a torque roll; keep that in mind when you start the maneuver.



LET'S GO!

Start by flying a fairly low downwind pass; then just before you pass yourself, reduce power by about a third. As you pass yourself, pull up into a quarter loop. The aircraft's vertical air speed will diminish rapidly owing to the throttle setting.

Here comes a crucial part: you must be absolutely vertical—especially when the aircraft stops climbing. Command of the rudder is also very important. Just before the aircraft stops climbing, start to add power to prevent the aircraft from sliding backward. It takes about 60 to 70 percent throttle to maintain the altitude of my Sukhoi.

Now that the aircraft has stopped and is hovering, the torque of the engine will roll the aircraft. Here comes the hard part: to continue the maneuver for more than half a roll or so, you'll most certainly need to put in some correction to keep the aircraft perfectly vertical; otherwise, the plane will simply fall out of the maneuver. You must also input the corrections very quickly. It may be rudder or elevator, so concentrate and be fast. It's kind of like learning to fly a helicopter nose-in—not easy! You'll quickly find that it's easy to figure which rudder to apply when you're viewing the top of the aircraft, but as it rotates and you see the bottom, rudder is, of course, "backward." Here's a trick to help you out: let's say you need to make a correction with left rudder as you see the top of the model and as it rotates: neutralize your rudder command as you see the side profile of the model, and give opposite (right) rudder as you view the bottom. Get the idea?

Of course, throttle management is important, too. It takes power to torque the fuselage around, yet too much will make it climb, and too little will make it fall. I never said it was easy. Another little trick to help the plane to torque: allow the plane to slide backward ever so slightly. This allows you to use a bit of extra power to "check" the fall, and the higher power can really get the plane rolling.

IN CLOSING

Well, that's about it. Now all it takes is practice to get the thumbs to wiggle the sticks in the right direction, in the right amount and, of course, at the right time. Next month, we'll discuss tail slides; they're easier.

**Addresses are listed alphabetically in the Index of Manufacturers (for page number, see table of contents).* ■

MODEL AIRPLANE CONSTRUCTION NEWS MAGAZINE

An entry-level, scratch-building project that can give you your wings

The LITESTIK

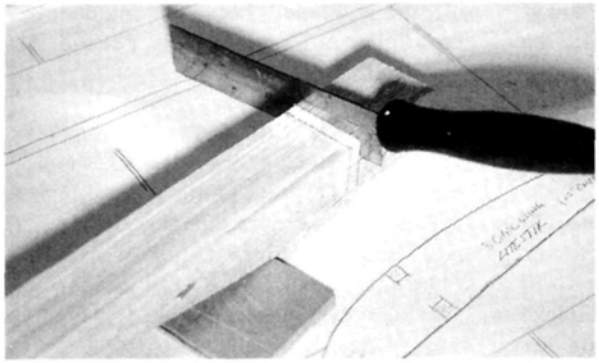
by GEORGE WILSON

STICK-TYPE R/C trainers are much "under-used," in this writer's opinion. They're inexpensive, they fly very well in the novice trainer role, and they're easy to build and repair. The version presented here borrows from a long line of predecessors (see the sidebar on "Stick History"), the last of which is the Balsa USA Stick 40—an excellent intermediate trainer. My goal was to design a lighter trainer (hence the name, "Litestik") with the forgiving nature beginners need. It uses a .25 engine that's more than enough for it.*

The author shows off his Litestik. Later versions used wire main gear. Commercial aluminum gear is available for those who do not feel comfortable working with metal.

PHOTOS BY GEORGE WILSON

What is a good trainer? Simply, it's any plane that's easy to build, fly and repair. Additionally, it should be inexpensive. With the Litestik, the building materials and the engine are the obvious "cost drivers." Another desirable feature is that as many of the model's working parts as possible be exposed to facilitate inspection, adjustment and repair. One of my pet peeves is a tank that's difficult to service, so most of my designs have exposed tanks (not pretty, but several fliers have found it convenient to be able to check the fuel by making a slow flyby).



Making ribs is simpler than it may seem to the inexperienced scratch-builder. Here, the notches for one of the spars are being cut with a razor saw. The ribs were cut, stacked and sanded previously. Note one of the T-pins used to hold the stack together.

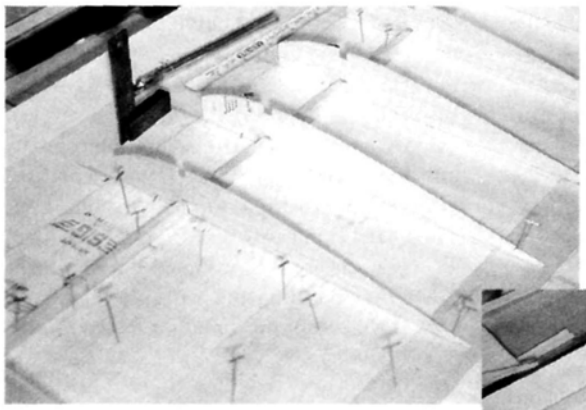
Light models make better primary trainers than heavy ones. The limitation here is a model's ability to fly under windy conditions. But should a novice be flying in wind?

I kept down weight by using: a small engine, pine fuselage sticks, medium-weight balsa,

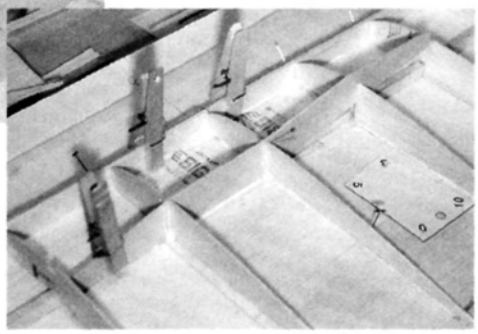
SPECIFICATIONS

Type: primary R/C trainer
Wingspan: 59 in.
Length: 42½ in.
Weight: 60 oz.
Wing loading: 12 oz. per sq. ft.
No. of channels req'd: 3 or 4 (rudder, throttle and elevator/with ailerons; see text)
Airfoil: flat-bottom
Wing material: wood
Washout built in?: yes
Engine used: Fox .25 or similar
Prop used: 10x6

Features: easy-to-build-and-repair primary trainer that can be upgraded to four channels by building an aileron-equipped wing. Cost, including plan, engine, radio and all building materials should be approximately $250—much less, if your scrap shelf is good to you and you have "a little help from your friends."



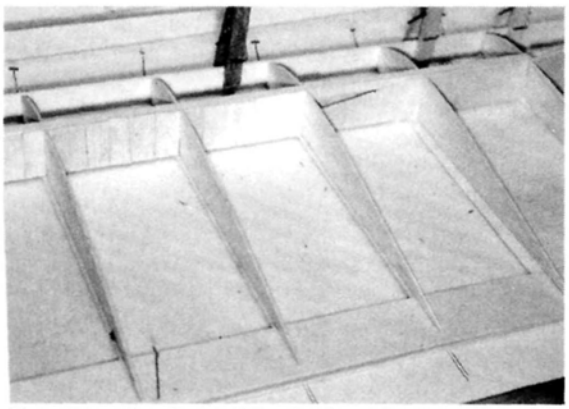
Left: the wing is built over a piece of paper with a few lines drawn on it. The author likes to save his plans and uses this approach for most building. The plan quickly gets covered up by the structure and really serves little purpose when built over.



Above: the wing halves may be built at the same time if your building board is big enough. The author uses a 16-inch flush door for wing construction. Note the dihedral brace already built into one half. The spars and leading edge should be trimmed to the dihedral angle.

built-up tail surfaces, light wheels, a small horizontal tail, Micafilm covering (strengthens, as well), hollow wingtips and a double D-tube wing. The strength, lightness and rigidity of this type of wing construction is very difficult to beat.

As the plan shows, beginners should build a Litestik with 5 degrees of dihedral on each side and no ailerons. When that version has served its initial trainer function, build a second wing with 2 degrees of dihedral on each side and 1/2-inch strip ailerons. Mount the aileron servo in a cutout on the top of the wing with the linkage exposed. This version of the 'Stik is called "Litestik+." It will do all the basic maneuvers, including inverted flight and barrel rolls. A good .25 will easily fly the aileron version.



Here the main wing webbing is shown in place. Note that the grain is vertical. The author uses scrap balsa of any reasonable thickness for the webbing. Later, webbing is added between the bottom and top sheeting at the front edge of the rear sheeting. Washout is added to the wing panels before the webbing is installed. This type of wing construction is known as "double D-tube," and it produces a very strong, warp-free but light wing.

CONSTRUCTION

When scratch-building, you'll save a great deal of time later if you "kit" the parts before you start. Your "kit" should be much the same as the commercial equivalents: wing ribs, bulkheads, fuselage sides, sticks," spacers and engine mounts for the fuselage; landing-gear parts; a dihedral brace; the required sheet and strip balsa; miscellaneous hardware, etc. Look at the list of materials, check your scrap box, and then visit your hobby shop.

THE WING

Make a rib template out of plywood (or a similar material), and cut the ribs out of 1/16-inch balsa with a no. 11 blade. Stack and sand the ribs, then notch them with a razor saw. They'll be ready before you know it.

Pin down the bottom spar over a blank piece of paper that has the spar's position and the trailing-end-sheet front drawn on it. Remember to first put wax paper over this drawing to prevent the structure from sticking to the paper. Mark the rib spacing on the rear of the spar using a piece of 3-inch sheeting as a guide. Then add the bottom capstrips and sheeting. Glue in the ribs, except for the center ones (these will be glued in when you construct the dihedral joint). Raise the rear edge of the wing with shims to create the 5/16-inch washout.

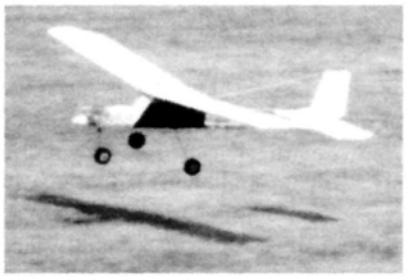
Add the center webbing at the spars and then the sub-leading edge. Pre-shape the sub-leading edge and the leading edge as shown on the plan. Install the leading edge and trim as necessary. Add the top sheeting (except at the middle at the center) and the capstrips.

The hollow wingtips are no real problem to build or repair. The tip sheeting begins one rib inward from the tip. Trace around the tip shape to make a template and, using the template, mark the top sheeting and trim the tip accordingly. Using a 4x10-inch sanding block with 80-grit paper glued to it

FLIGHT PERFORMANCE

• Takeoff and landing

Assuming that you fly off grass, when you power up the throttle, the Litestik will become airborne in about 50 feet. There's no need to finesse the takeoff with a little right rudder; just keep steering straight ahead. When it gets off the ground, it won't be turning either to the left or to the right, but will fly straight forward. When you land, power down to descend, and let it glide in. At the last second, give it just a little up-elevator, and stall it into a three-point landing when it's less than 1 foot off the ground.



• Slow-flight performance

This plane is a slow, docile trainer that flies itself with hands off the controls. When you really slow the Litestik down, its built-in washout helps to avert tip stalls. As you learn to use the controls, this plane will happily fly at a relatively slow rate. Throttle back until it maintains a level altitude and you're ready to fly a pattern.

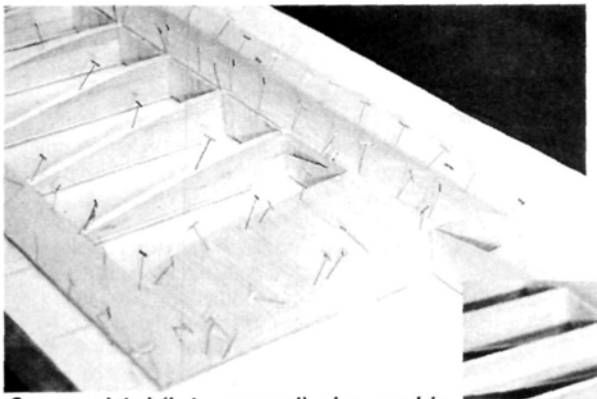
• High-speed flight

If you put the pedal to the metal, this airplane will just *climb!* It will fly faster, but it's no screamer; it flies more or less like a full-size Piper Cub.

• Aerobatics

The Litestik makes one of the sloppiest snap rolls you'll ever see! Dive a little, then pull the right stick back and right (or back and left for a left snap roll). The Litestik can't be coaxed through a roll because of its high pendulum stability. Make sure you have lots of altitude.

The aileron upgrade will make it an intermediate trainer with which you can gain aileron experience. With ailerons, it is still a bit sloppy in the air, but hey, it's intended to be an easy-to-fly trainer. With ailerons, you can coax the plane to fly upside-down, but it will require a good deal of down-elevator when inverted. If you get into a spiral dive, first level the wings and then pull up on the elevator. But loops are easy!



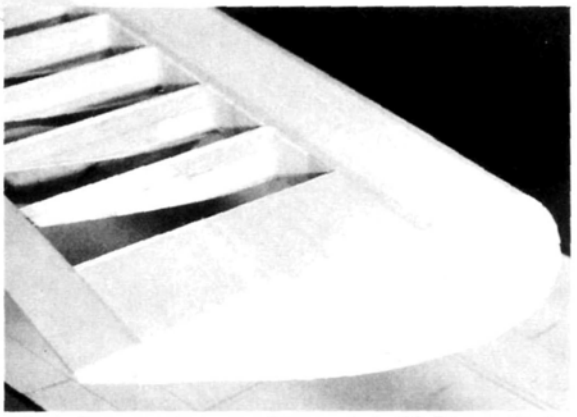
One completed (but uncovered) wing panel is shown here. The center sheeting on this panel may be added at this time, or when the second panel is joined to the first.

(I use white glue), sand the underside of the tip to make a flat surface. Then glue on the bottom sheeting with the grain running spanwise, trim and sand. (Incidentally, repairs are made by squaring up the broken area and gluing a balsa block into the hole. Trim, sand and refinish—no sweat!)

If you didn't build the two wing panels simultaneously, it's now time to build the second panel. Trim the spars, the leading edge and the sheeting to the dihedral angle.

Don't forget to allow for the wing washout in both wing panels. With one wing panel pinned to the building board, raise the other using a square block that measures about 2x2x12 inches. Set the dihedral angle using the dihedral brace. Fit the dihedral brace by trimming the center ribs as necessary. Glue the dihedral joint, the brace and the center ribs into position. Don't forget to angle the center rib to the dihedral angle. Add the center top sheeting, fitting it as necessary to the top of the center ribs.

Cover the wing's center section with Ace R/C* Polymat or a similar material, e.g., fiberglass cloth. This will protect the wing from being crushed by the wing hold-down bands and strengthen the dihedral joint. The primary strength at the dihedral joint is provided by the dihedral brace. Polymat is a flat material that can be applied with your choice of fuelproof adhesive (I use butyrate dope). It does not go around compound curves, but it may be trimmed to fit smoothly.



The hollow wingtips are quite easy to build. Trim to the tip outline first. Roughly trim the spars and leading edge to the tip angle using a razor saw.

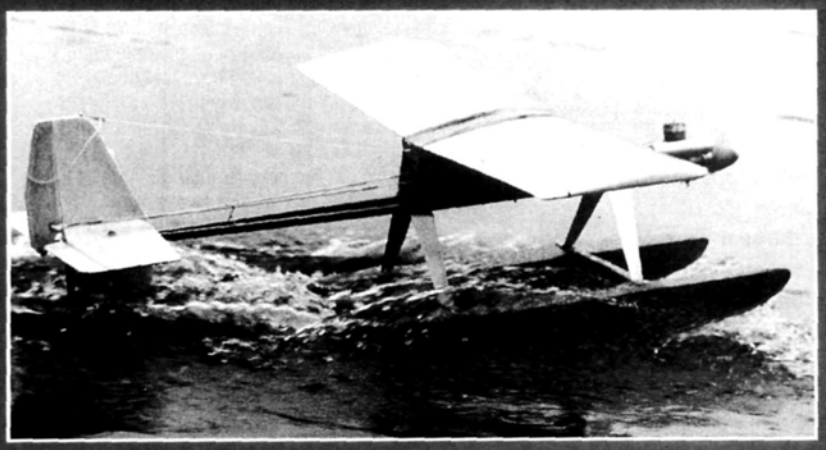
The aileron-equipped wing is built similarly except for the dihedral angle, ailerons and servo. Hinge the ailerons at the top using Sig* Easy Hinges, or use heat-shrink covering, top and bottom. Use Carl Goldberg Models'* no. GD-402 aileron horns (or something similar). After building the wing, build a box for the servo installation in the *top* of the wing.

FUSELAGE

If you don't have a bench saw to cut the fuselage "sticks," find someone who has one. The cuts are simple. Do not forget the taper at the bottom rear of the sticks that form the fuselage sides.

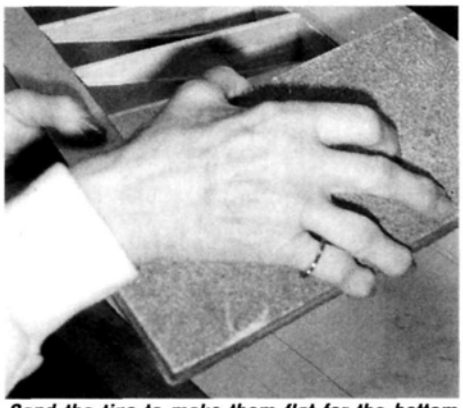
The plan shows a Fox* .25 engine. If you use a different engine, be sure to modify the mounts to fit it. To reduce drag, you may cover the open top and bottom areas between the fuselage sticks. Add lands (attachment points) as necessary to attach the covering—typically, as shown around the base of the optional fairing just behind the cabin. Attach the hardwood engine-mounting rails to the fuselage sticks; clamp and let dry thoroughly. Roughly trim the rear insides of the sticks as shown on the plan; final trimming is done when the ends are drawn together later. Cut the

Stick Design History



The Stick design has its origins with the rubber-powered stick models of the 1920s. The first published "gas"-powered stick was the 1936 Flying Aces Stick by Bill Effinger and Tracy Petrides (for an updated version, see the February 1990 issue of *Model Airplane News*). Kwik Stick by George Chabot was published in about 1970, and my Seastick was published in the April 1977 issue of *Model Airplane News*. There may have been others, but they did not pop out of my file. The Balsa USA Stick 40 is the active representative of the breed.

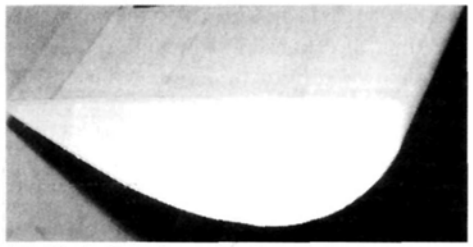
The word "stick" has lately been misused to describe models with built-up fuselages. These designs have their place, but true sticks they are not. Obviously, the stick design's top feature is its simplicity. Carl Goldberg was fond of quoting Antoine de Saint-Exupéry's words from his book, "Wind, Stars and Sand": "A design is not perfect until all has been removed from it that is not essential." The stick approach meets this criterion and perhaps has a couple of features that would especially please Saint-Exupéry. Typically, the "cabin" that protects the radio gear also serves to position the wing correctly. Here, two-for-the-price-of-one simplification is achieved. The stick design is the simplest, most inexpensive and easiest to repair R/C trainer that you can build. Additionally, it's a great trainer.



Sand the tips to make them flat for the bottom covering, and then add the triangular tip ribs (see plan). Re-sand to ensure that the bottom covering will be flat when it is installed.

stick spacers that will be installed from the nose to the rear of the cabin; these are all the same length.

Mark a nose-to-tail center line on your work surface. Pin one fuselage stick top-down to your work surface, spacing it properly from the center line. (Don't forget the wax paper.) Add the spacers and the nose-gear mounting pieces. Drill the pine nose-gear mount for the wood screws that will later be used to hold the gear in place. Then add the remaining stick using a square to



The tip bottom is made of random short pieces with their grain running spanwise. These pieces are then trimmed and sanded. The author feels it is easier for a novice to build a hollow tip than to cut, carve and finish a tip made out of a balsa block.

ensure that both sides are even at the nose. Let this much dry thoroughly.

Draw the sticks together at the tail, and glue them together directly over the center line. Add the stick spacers from the cabin to the tail, cutting them to fit the space. Don't try to force the sticks to fit the plan. Remove this much from the board, turn the assembly over, and again pin it to the board with the nose-gear mount hanging over the edge of the board.

Now it's time to plan your control installation. Unless you have servo-reversing in your transmitter, be careful that your controls will work in the proper direction. Mark the positions of the pushrod holes in the bulkheads, and then drill them. The servos may be attached to the cabin sides and

WHERE USED	MATERIAL	QUANTITY
•Wing ribs, sheeting, capstrips, webbing, etc.	1/16-in. sheet	8 sheets 2x36 in. 2 sheets 3x36 in.
•Wing spars	1/4 sq.	2 strips 36 in.
•Wing spars	1/4x3/8 in.	2 strips 36 in.
•Trailing edge	1/8x3/16 in.	2 strips 36 in.
•Leading edge	3/8x3/4 in.	2 strips 36 in.
•Fuselage sticks	1/4x3/4x40-in. pine	2 strips
•Engine bearers	3/8-in. hardwood	1/2x12 strip
•Gear mounts, etc.	3/4-in. soft pine	3x6-in. sheet
•Dihedral brace	3/32-in. A/C ply	6x12-in. sheet
•Cabin, tank floor, etc.	1/8-in. lite-ply	12x24-in.sheet
•Tail surfaces	3/16-in. sheet	3x36-in. sheet
•Wing dowels	1/4-in. birch	1 length 12 in.
•Pushrods	1/8-in. birch	1 length 36 in.
•Pushrods	Nylon	1 length 36 in.
•Main gear	1/8-in. music wire	1 length 36 in.
•Wheels	1—2 1/2 in.; 2—2 3/4 in. *(light type)*	
•Wheel collars and washers	2—1/8; 1—5/32 in.	
•Miscellaneous	1/8-in. sheet	1 sheet 2x18 in.
•Nose gear	Sig SH-695	
•Nose-gear bearing	Goldberg GD-262	
•Tank	Sullivan* SS-6	
•Fuel tubing	1 length 1/8x12 in.	
•Hinges	6 Sig Easy Hinges	
•Clevis/links	6—2-56	
•Horns	2 Du-Bro* DU-105	
•Gear straps	Goldberg GD-291	
•Wing reinforcement	Ace R/C* Polymat	
•Wood screws	4–5x1/2, 4–6x3/4	
•Covering	Coverite Micafilm or similar	
•Engine	Fox .25 or similar with hardware	
•Spinner or AMA prop nut	1 3/4-in. diameter	
•Propeller	10x6	
•Radio, adhesives, clear and colored dope, and seating tape	**ALL MATERIAL IS MEDIUM BALSA UNLESS OTHERWISE NOTED.**	

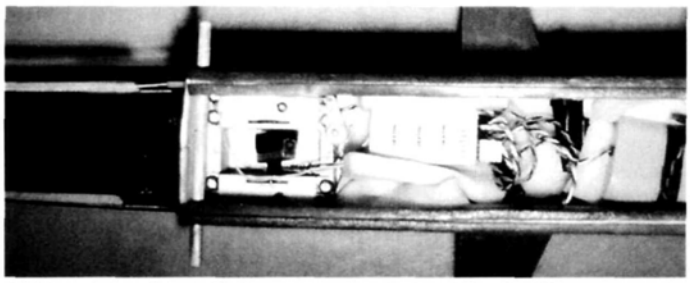
floor using double-sided tape or a more elaborate means. The pushrods are easily made in accordance with the plan. Install the cabin floor and the rear bulkhead; make sure it's square crosswise and vertically. Install the cabin sides; be sure to drill the dowel holes. Add the front bulkhead; sand the bottom to make it fit neatly. Add the floor that will be under the tank. Install the doublers inside the top of the cabin. Add the hold-down dowels after the fuselage has been finished or covered.

LANDING GEAR

If the steerable nose wheel looks too challenging for you, it may be omitted and a tail wheel or a skid used in its place. The nose wheel, however, even if it isn't steerable, is highly recommended to help save propellers while you're learning. If you go the tail-dragger route, the main wheels must be an inch or so in front of the balance point. Again, if you don't want to make the wire main gear, use a Sig no. RP-BA-249 aluminum gear, or something similar. The gear mount on the fuselage will have to be modified to suit this type of gear.

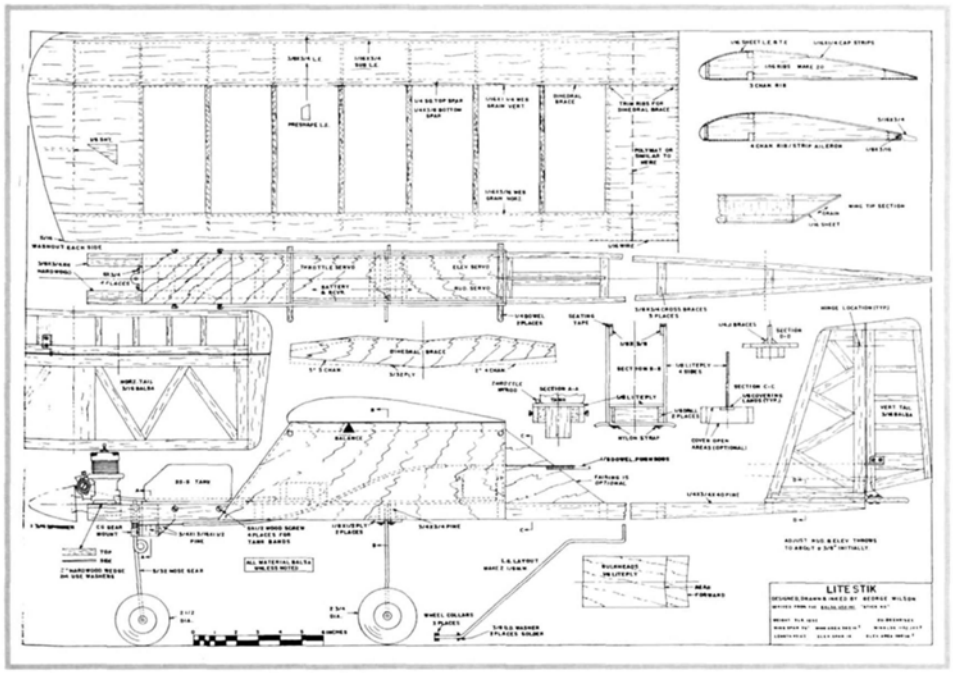
If you choose to go with wire gear, bend the main gear as shown on the plan using a vise or a wire bender. Solder the

(Continued on page 64)



This equipment installation used pine servo rails, but the servos may simply be mounted on the cabin sides and floor using double-sided servo-mounting tape. The throttle servo is under the (heavy) battery that is as far forward as possible for balance. Note that this Litestik used aluminum main gear.

wheel "positioners" (washers) into place. Make flats in the gear wire for the setscrews in the wheel retainers and in the nose-gear strut for the nose-gear horn using a file or grinder. Fit and install the gear using the hardware shown on the plan.



ORDER THE FULL-SIZE PLAN...SEE PILOTS' MART...FSP07941...$9

You'll have to drill two 1/8-inch holes in the main gear mount to accept the vertical parts of the struts. Use metal or nylon straps to secure the main gear.

TAIL SURFACES

Build the tail surfaces out of 3/16x3/8-inch and 1/2-inch sticks, and 3/16-inch flat balsa. Weight saved in the tail is most valuable; it takes three or four times as much up front to balance it out. Shape the edges as shown on the plan, and sand the surfaces flat using the sanding block that was used for the wingtips. Sig Easy Hinges (or similar) are recommended, especially for the novice builder. Cover each part of the tail separately, and then hinge the parts and install the control horns.

COVERING AND FINISHING

It's worth learning to use Coverite's* Micafilm. Its lightness and great strength make it ideal for any medium to large model. It sags only very little with age, and its warp control is outstanding. This feature alone has saved me many hours of rebuilding and recovering. Surface dings come out quickly with a touch of heat from an iron or (carefully) with a heat gun. Follow Henry Haffe's directions that come with the Micafilm; don't do as I did and try to use your past experience with other iron-ons: Micafilm is easy to work, but it *is* different. Be sure to wrap it around the edges well so that heat applied to shrink it does not soften the edge bond and allow it to loosen. Other heat-shrink materials are acceptable and may be easier for novice builders to use. Oracover* and Ultracote* are excellent choices for first-timers.

Before joining them, cover the tail parts individually, leaving the areas to be joined (including the top rear of the fuselage) bare. Thoroughly seal the fuselage with a fuelproof finish. The original fuselages were coated with three coats of clear nitrate dope, one coat of colored dope and two coats of clear, low-shrink, butyrate dope.

FINAL ASSEMBLY

Install the wing-seating tape on the top of the fuselage. Install the engine with about 2 degrees of downthrust. (Put a shim or washers under the engine's rear mounting holes.) If the mounting holes have a bit of slop in them, angle the engine to the right. (This isn't at all critical.) Install the wing hold-down dowels and seal them with a fuelproof finish.

Hinge the elevator to the horizontal stabilizer and the rudder to the vertical stabilizer. Mount the vertical tail assembly on the horizontal tail making sure that they're at right angles vertically and fore and aft. Then mount this assembly on the fuselage making sure that it's level horizontally and that the vertical tail is aligned with the center line. Take your time. These steps are important.

Install your control system and the pushrods. Check and make adjustments as necessary to see that the neutrals are correct and that the throttle travel is about right. If making these adjustments bothers you, get some experienced help. If you don't have servo-reversing, make sure the rudder, elevator and throttle work in the right directions. The rudder and elevator throws should be about 1/2 inch on each side.

Check the flying surfaces for warping and, if necessary, remove the warps using a heat gun. Check the balance point and add weight as necessary. The *initial* balance point should be about 1/4 inch forward of that shown on the plan. Later, it can be moved rearward to make the model more responsive to rudder and elevator.

At this point, a novice should have an experienced modeler re-check all the final assembly steps. It's better to find out that you have problems now than to discover them at the flying field.

CONCLUSION

I think the "Stick" concept is close to ideal for trainer models. It meets the cost, building, flying and repairing requirements of learners. Further, its simplicity makes it an ideal first scratch-building project.

I thank my test pilots Ed McCarty and Hans Sagemuehl. It sure helps to have a good team!

**Addresses are listed alphabetically in the Index of Manufacturers (for page number, see table of contents).* ■

5TH ANNUAL

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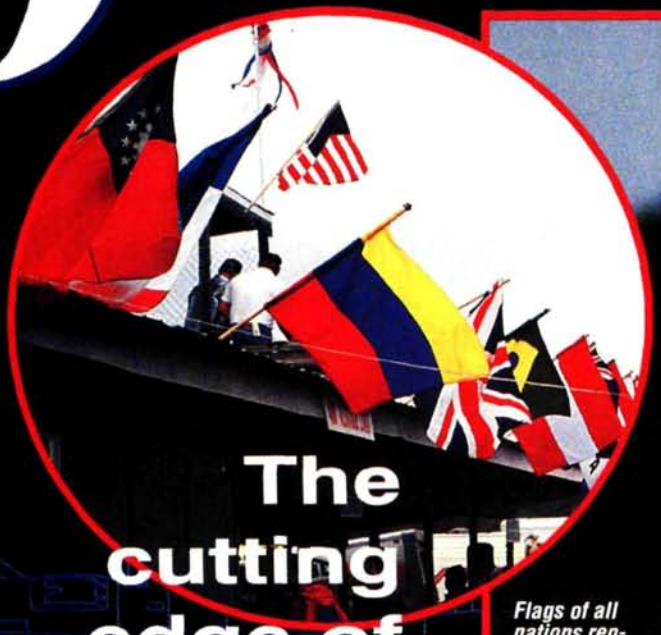
Jets Over D



The cutting edge of R/C

by DAN PARSONS

Flags of all nations represent the pilots who participated in this largest of all jet flys.

THIS ARTICLE IS written not just for the R/C ducted-fan/turbine enthusiasts but for all R/C modelers who are interested in new and challenging developments in R/C. I'm not a ducted-fan/turbine flier myself, but I've been interested in and watched in admiration the development of ducted-fan models over the last 17 years. The trials, tribulations and frustrations of the pioneers in this most demanding of all R/C flying endeavors have been many, but so have their successes.

The successes were brought home to me dramatically when I attended the fifth annual International Jets Over Deland Fly-In held near Deland, FL, January 27 through January 30, 1994. One hundred and sixty-two pilots, including 25 from 13 countries, brought 225 jets and kept the sky busy from six flight stations.

The rarely seen A-7 Corsair. A large, bulky n once it got on the step.

Philip Avonds' large F-15 just after liftoff; O.S. .91; Ramtec fan; 14.3 pounds.

ON THE FLIGHT LINE

But the really exciting news is that there were three, I repeat, three designers/manufacturers of true jet turbine engines flying them in various scale and sport models. The JPX-T240 unit made in France has been flying in demonstrations around the U.S. for the past two years. But now there are two new turbines, the Schreckling-FD3/67 LS from Germany and, I'm very proud to report, the Seymour turbine from the U.S. More details on all of these later.

eland

PHOTOS BY DAN PARSONS

Bob Fiorenze checks the engines on his Yellow Aircraft F-14 Tomcat just before flight.

Carl Spurlock flew a smooth, excellent routine with his big Byron F-15.

Bob Fiorenze's F-14 Tomcat just after liftoff.

Though this meet's official dates were Thursday through Sunday, Frank Anderson, the CD, told me fliers began arriving as early as Monday to tune up and take advantage of flying from the fine facilities of the Deland Golden Hawks R/C Club field, i.e., the 1,600x200-foot concrete runway.

When I arrived early Thursday morning before the scheduled flying had started, there were already 120 registered pilots, and it appeared that most had their planes in the pits ready to go. After a brief pilots' meeting with plenty of stress on safe flying, the fun began.

INTERNATIONAL FLIGHTS

Over the years, I've attended three or four of the Southwest ducted-fan fly-ins and seen ducted-fan models at many meets around the country, so I'm primarily covering just the planes and equipment that were new to me. And there were plenty to check out and especially photograph in flight (my other passion in R/C, besides flying twin-engine prop models). Unfortunately from a photographer's viewpoint, it was very cloudy most of the time but, more important, the clouds and occasional light rain on Saturday didn't keep the fliers from doing their thing.

One of the first planes into the air on Thursday morning was

(Continued on page 75)

Bob Violett's new F-80 from his latest kit; 72-inch span; BVM .81 and fan; 15.5 pounds.

The Sukhoi 27 fighter was designed, built and flown by J.P. Meier from Switzerland; two O.S. .91s; 25 pounds. Its top hatch blew off during the flight.

a fine-looking F-15. Its maneuverability and slow-flight capability combined with the smoothness of the entire flight, which was finished off by a series of perfect touch-and-go's, made for a very impressive show. And no wonder, the pilot was Philip Avonds from Belgium, who won the Scale World Championship in 1988 and 1990 with the F-15 he designed and now kits.

Hans Van Dongen's Rafale A from the Avonds kit; O.S. .91; Ramtec fan; 12 pounds.

Bob Fiorenze buries his hands in his complex Yellow Aircraft F-14 Tomcat. That "smile" is the best I could get from him!

With a length of 85 inches, his F-15 is a large, but just-right-size F-15. Weighing only 6.5 kilos (14.3 pounds), the single O.S. .91 turning a Ramtec fan (distributed by Aeroloft Designs*) flies it with authority. By careful design, using only one engine, no rudder or flaps (not needed), Philip has followed the KISS principle with excellent results.

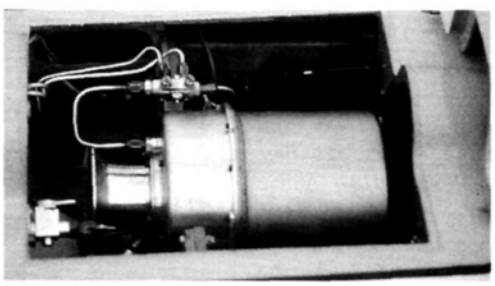
Shortly after the F-15 flight, a scale model certainly new to me and many others took off and put on a marvelous show of aerobatics finished off by almost hovering flight in the 15mph winds. Several touch-and-go's preceded a perfect touchdown and roll-out. The plane was a Rafale A—a delta configuration with canard winglets placed just aft of the cockpit. The obviously very accomplished pilot was Hans Van Dongen from Holland. Friendly and speaking perfect English, Hans gave me the info on this fine flying machine: O.S. .91; Ramtec fan; 5.4 kilos (12 pounds); and it's from a Philip Avonds scale-jet kit. I commented on his touch-and-go's (rarely seen with ducted fans), and he replied "It is my favorite maneuver." A man after my own heart.

Above left: Jeff Seymour's F-18 Hornet is powered by a 38-pound-thrust (de-tuned from 60 pounds) turbine engine and piloted by Bob Fiorenze. Above right: Bob Fiorenze's Yellow Aircraft F-117 Stealth fighter/bomber just after takeoff. The model was so stealthy that my camera couldn't focus on it!

AMERICAN BLOWTORCH

When I had first arrived at the field on Thursday morning, I heard what I thought was just a rumor: that there was an American-designed, kerosene-burning turbine engine that developed the unheard of (to me) 38 pounds of thrust and that it was installed in a Yellow Aircraft* F-18 Hornet and would be flown. It was no rumor!

Course, almost everyone was waiting for this creation to blast off. So, when Jeff Seymour*, the designer and builder of the turbine, checked it out prior to flight, all eyes were on that Big Red, 45-pound Hornet. With everything in order, the engine was lit off, and Bob Fiorenze, Jeff's test pilot, taxied out, turned into the wind, truly spooled up with the brakes set, released the brakes and went roaring down the runway. He rotated opposite my position, assumed a 30-degree angle and climbed out. With that tailpipe now pointing at me, it was a roar, or maybe a blast is a more accurate description. Only the tongue of flame of an afterburner was missing. I'd never heard anything like it in modeling.



Jeff Seymour's turbine engine in the Yellow Aircraft F-18 Hornet. Note all the room!

Because this engine is a test bed for Jeff in proving his design and development concepts, his big Yellow Aircraft F-18 is flown conservatively by Fiorenze (I know that's tough for you, Bob). Even so, the high-speed flybys at about 30 feet were absolutely tremendous in their visual and audible impact. I've never seen anything like it, and I've been to most of the big meets all over our country.

The amazing thing is that Jeff's experimental turbine is capable of producing around 60 pounds of thrust, but he limits it to 38 pounds in the F-18 for obvious reasons. Even with this de-tuned performance, Bob told me he used full power only on takeoff and on the steep climb-out, and during long, vertical pull-ups. At reduced throttle on the straight and level flybys, he

AWARD WINNERS

Best of Show: Rafale A (Avonds kit)—Philip Avonds (Veurne, Belgium)

Fastest Jet: Ultra Viper (BVM kit)—175mph (no dive; flat run)—Terry Nitsch (Columbus, OH)

Slowest Jet: Rafale A (Avonds kit)—21.1mph—Philip Avonds

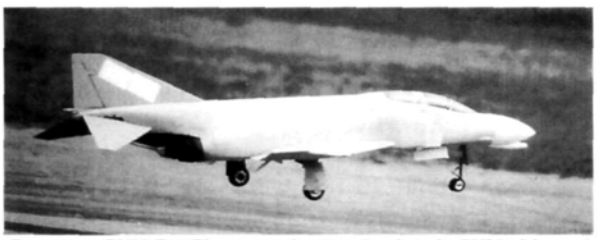
Quietest Jet: Electric MiG-15 (original design)—Dave Ribbe (Champaign, IL)

A close-up of Tom Cook's T-33 with the huge access hatch removed. Look at all that space!

Bob Violett (second from left) with his latest creation: a 72-inch F-80.

estimated the speed of that big Hornet to be 170mph. To call the flights of this machine awesome is an understatement, believe me!

Jeff was quick to point out that his experimental turbine engine is not slated for production for modelers' use. But a smaller version, the SWB-4, is under development for use in many of the kits now on the market. Oh yes, this production turbine is designed to produce only 20 pounds of thrust! And, like its big brother, it will use kerosene.



Prototype BVM F-4 Phantom about to land; twin BVM .91s and fans; 24 pounds. Bob Violett takes the controls for the second flight.

Before the first flight of Big Red, I just happened to sit down in someone's empty chair and started chatting with the fellow sitting next to me. Turned out he was Walt Seymour, Jeff's father, and he gave me a quick rundown on his son's 15-year design and development effort on his turbine engines.

VIOLETT SQUADRON

At any jet fan fly in our country there is always a high percentage of models from the Bob Violett Models* (BVM) stable, and this meet was no exception. Besides the many Aggressor and Viper sport models and F-16s and F-86s, there were several of the relatively new T-33s and his latest sport model, the Maverick. But the completely new introductions were the F-80 and F-4 Phantom.

First, the F-80: with a 72-inch wingspan and weight of 15.5 pounds, it is smaller and lighter than the T-33. As such, Bob uses the BVM .81 vs. the more powerful BVM .91 in the T-33. This appears to be a perfect engine match since Bob's flights with his prototype were as impressive as with his, by now, well-proven T-33.

And now the F-4 Phantom: still in primer gray with no markings (tough for in-flight pictures), Bob taxied it down to near the end of the runway, turned and lined up on the white line. With the brakes full on, he powered up those two BVM .91s to full thrust then released the brakes. Acceleration was rapid, but he kept her on the white line for a long, scale-like run. After a smooth liftoff, he sucked up the gear and rotated to about a 50-degree climb angle and blasted right on up to about 1,000 feet. Again, the only things missing were the long tails of flame of afterburners.

He then proceeded to put on a show of slow rolls, point rolls, huge loops, reverse Cuban-8s, etc. And this was only the second flight on his prototype. His smooth touchdown on the main gear followed by a long, straight run out completed a flight that can best be described as magnificent. This F-4 is big, but not too big—just right. And with a plane weighing only 24 pounds, those BVM .91s produce near scale vertical performance and the best I've seen for an F-4. By the way, Bob Violett not only produces top-quality designs and kits but is one of the best R/C pilots going.

Bob Fiorenze's Yellow Aircraft F-18 Hornet on a fast flyby.

TOM'S T-BIRD

Tom Cook of Jet Model Products* and one of the true pioneers of ducted-fan technology was there with his beautiful 85-inch T-33. His kit—a recent release after several years of development—is perhaps unique among American-made kits. It is made entirely of molded fiberglass, and it is of outstanding quality. I've known Tom since the first Scale Masters Championships in 1980, where he flew his revolutionary and sensational twin-engine F-4 Phantom to first place. Excellent design capabilities and first-class quality have always been Tom's trademarks, and his new T-33 kit carries on this tradition.

Bob Fiorenze flies his big F-14 Tomcat.

Bob Fiorenze's Yellow Aircraft F-18 Hornet just after rotation at liftoff.

And he has certainly not lost any of his flying ability. His flights on his big T-33 were smooth and realistic to perfection.

Close-up of Bob Violett's new F-80 with the generous hatches removed.

The O.S. .91 turning Tom's own Dynamax fan unit provided excellent maneuverability and vertical performance for his 24-pound T-33. Pushing a plane this large and weighing 24 pounds so well with only one engine says worlds for his complete design package.

On his last flight, I informally judged

his takeoff. After a long takeoff run and a smooth, low-angle liftoff with the gear simultaneously retracting at the correct rate, followed by a gradual climb, there was no hesitation on my part in judging it a "10." If there were any full-scale T-33 pilots watching closely, I bet there were nostalgic lumps in their throats.

Tom is working with Jeff Seymour to allow Jeff's SWB-4 turbine to drop right into the T-33; what a combination that is going to make.

NITSCH FLIES

Anyone who has ever watched Terry Nitsch fly his always beautiful BVM Vipers, Aggressors, F-16s or F-86s can spot his style of flying immediately: perfect vertical rolls almost out of sight, huge, round loops that start right on the deck and end up there, long slow rolls and point rolls, reverse Cuban-8s and other neat maneuvers. Course, all the while, everything as smooth as silk. To top it off, I believe he still holds the speed record for ducted fans (227mph) with his Super Viper. Needless to say, he was doing his thing at this meet. Not one to let others always do all the work while he's having fun, Terry runs the Heart of Ohio Jet Scramble held at Darby Dan airport, a few miles west of Columbus, OH. Dates are August 26 through the 28. For details, you can contact Terry at (614) 870-1415.

INTERNATIONAL ATTENDANCE

Besides the previously mentioned fliers from overseas, there were other notables doing their thing. Mike Cherry, editor of *Radio Control Jet International* magazine produced in England by Traplet Publications, was not only being a reporter, taking pictures, both static and in-flight, but flying also. And his plane? A Saab Viggen powered by the new Schreckling, kerosene-burning, turbine engine. His magazine, though relatively new, has already become a "must" for the serious ducted-fan/turbine modeler.

John Franklin, editor of another English magazine, *Aero Modeler*, was also present and accounted for.

All the way from Bangkok, Thailand, came Maung Zaw, who consistently flew his Rafale, which he built from the Avonds kit. Talk about an enthusiastic, friendly guy! He tied for the Pilot Traveling Farthest to Fly award with Peter Stefurak of Melbourne, Australia.

Two other well-known ducted-fan fliers from England, David Gladwin and Malcolm Kay, were doing their thing with

(Continued on page 82)

SIMPLE PROGRAMMING

DAVID C. BARON

LINKAGE SETUP AND FLIGHT TRIM, PART 2

THIS ISSUE, I'll follow up last month's discussion on modifying flight characteristics with your programmable radio. I'll continue with trim memories, throttle setups and flap positions.

To adjust these radio functions, you may have to operate your engine and even fly with the edit section of your transmitter open. This may seem dangerous at first, but the current Futaba*, JR* and Airtronics* radios are fully interactive and operate normally when they're in the adjustment or edit mode. Ask someone who's very familiar with your aircraft and your radio to help you so you won't have to take your eyes off your plane (or your hands off the transmitter controls) while the engine is running. Have someone else hold your aircraft securely when you make changes.

The new JR XF622 is an example of the next generation of programmable radios. The emphasis is on a lower price and good programming capabilities. I'll tell you more about it soon.

TRIM MEMORY

You realize the benefit of trim memory when you move between your transmitter's multiple memories. Because you can custom-adjust the trim values for each memory, this function ensures that the trims for all of your models are centered. When you jump from one memory to another, your model will be in trim; you won't be faced with a test flight every time you switch memories. This function is only meant to make minor corrections, and you should still adjust the clevises on your pushrods when substantial trim changes are necessary. This way, the electronic trims stay as close to neutral as possible.

Many modelers abuse this function by repeatedly using it as their only means of making trim changes. This can cause the model to have more control-surface throw in one direction than the other. Here's why: most of our radios allow about 30 percent trim authority. This means that approximately one third of our total motion can be displaced by the trim levers and/or the electronic trim functions. If these values are allowed to go to extremes, you'll notice that your plane's control-surface throws will shrink in one direction. When in flight, your plane will roll faster in one direction than the other.

ATV

You've made your best estimates of what the control throws of your new plane should be by intuition, or by using the suggested throws of the building instructions. After the first flight, the adjustable travel volume (ATV) function is the most commonly manipulated control. This function sets the outside range of control throws, i.e., control surface or throttle movements. Many experienced modelers have an alternate set of values in their dual rates (for aileron and elevator) before the first flight. Note that if your CG appears to be at the aft end of the range shown on the plans and is likely to produce a potential roller-coaster ride, using dual rates on the

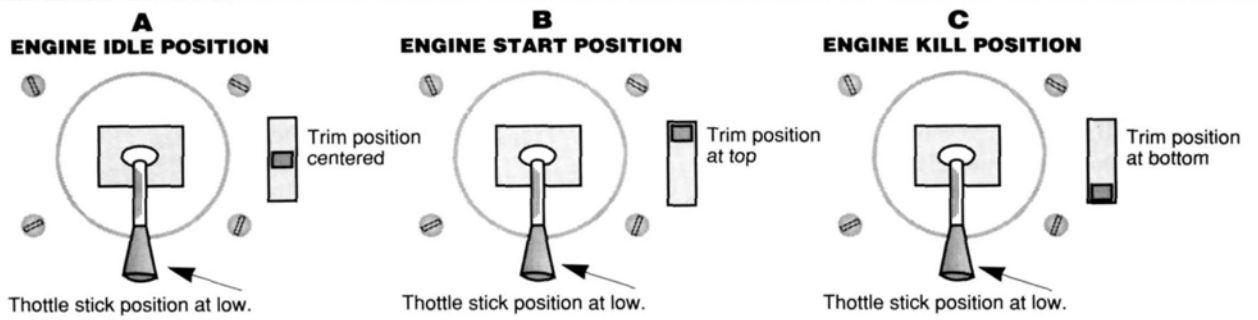


Figure 1. ***The throttle trim should be set for a reliable idle with the lever set in the center. The trim should be placed at the top position for starting and at the bottom for a positive engine kill.***

elevator channel is especially prudent!

ELEVATOR ATV TIPS

I adjust my maximum throws so that (at full throttle) I get the tightest loop possible without snapping out. I make modest adjustments at the field during a series of short flights; the results usually serve me well, regardless of air speed, in all throttle settings.

THOTTLE ATV TIPS

Like the other channels, during initial setup, it's easy to see that the direction of travel of your throttle linkage is correct and that there's no binding. This is enough for you to test the engine. Now you can set up specific points of your trim lever to be high idle, low idle and engine kill (see Figure 1).

You'll need to set your transmitter to the ATV function. Next, verify that the transmitter is in the proper mode to manipulate the throttle servo at the low end. Visually find a carburetor setting that allows a safe engine start. Start your engine as usual. If you run the engine by yourself, make sure that the model is secure. Check the high- and low-end needle settings, and adjust for smooth throttle operation. If you're unfamiliar with your engine, refer to its instruction manual.

The Airtronics Quasar is another example of the new, less expensive, programmable radios. It has simplified programming and is available in fixed-wing and heli versions.

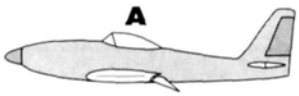
Set the throttle to the low stick position with the trim in the middle of its range, and adjust your "+" or "-" cursor until you achieve a satisfactory idle. If it stalls, you may need to restart the engine a couple of times and perhaps readjust the idle-mixture needle setting for optimum idle. Now test the low-throttle trim position for a positive engine cut. When you start your engine, the stick should be at the low setting with the trim lever all the way up.

FLAP/ELEVATOR TRIM

Most popular programmable radios have flap switches that give you a single-position setting for a given value of flap deployment. After you have had some experience with the aircraft, you should adjust two values that are keyed to this switch: the amount of flap deployment and elevator trim (which corrects for nose pitch-up or pitch-down resulting from flap deployment). I start by experimenting in flight with the main flap-adjustment knob or lever on the transmitter face. I first look to see how much elevator trim is required (and in which direction) when the flaps are deployed (see Figure 2). Next I evaluate how much flap throw is needed to give me the rate of descent that I desire. I then set these values into the 6-2 mix function and its required flap and elevator values. This is also fine-tuned during a series of short flights.

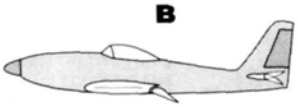
Figure 2

A



Application of flap causes a nose-up or nose-down trim change.

B



Flap position and elevator trim should be mixed for a consistent rate of descent. Experimenting at altitude will help you to determine the best setup.

SERVO-REVERSING

Emergency reversing! Shame on you! Actually, I've been in this embarrassing situation: a fraction of a second after launch, my finely honed senses indicate that the controls appear to be backward. So much for a thorough preflight. If you have a helper who can open the edit section of your radio programming without knocking the transmitter out of your hand, have at it. In the meantime, remember the following: if the elevator is the culprit and you're proficient at flying inverted, you may get away with it. Keep your head while you deal with the dilemma.

If the ailerons are backward, you haven't got a lot of time for mental games. I've seen this situation successfully addressed by quickly turning the transmitter around 180 degrees. Then, of course, the elevator is backward, the control stick is now on the left, and the antenna is in the grass. If you save a valuable plane, it doesn't hurt to look like the Keystone Kops for a few moments!

ECONOMICAL RADIOS

I just got back from the WRAM show in Westchester, NY, and it's obvious that modelers are demanding less expensive, programmable radios that are still full of features. JR's new XF622 radio is a prime indication that manufacturers are listening. This 6-channel system is programmed for both aircraft and helis, it has a two-model memory and should be available by mid-spring. Expect it to be dis-

counted so that it will cost around $250! I've been told that this system will set a new standard in ease of operation, so I look forward to telling you about it very soon.

Many major manufacturers are bent on offering the best value and the lowest price on programmable radios. A little price war between them won't bother us consumers one bit. Expect 1994 and '95 to usher in a new generation of less-expensive radios with ever-increasing capabilities.

Have you stopped to consider how good our radios have become? I remember that not too many years ago, most modelers had clunker planes to check out new systems before they risked more precious craft. I haven't seen a lemon radio in quite a few years. We all reap the benefits of new technology.

DREAM RADIOS

In a future column, I'd like to have a wish list of features that we'd like to see on future radios. If you've ever wanted to voice your opinion about which features the next generation of radios should contain, pick up a pen and jot down your ideas. I hope to offer a top 10 list of great ideas.

For example, on the mechanical side of things, I'd like to be able to remove the stems of the switches that I don't want or need. I know many people who would eliminate the potential disaster of the training switch, if they could. Our radios could start to look less like porcupines.

So let's hear your ideas, whether they're mechanical improvements or programming needs. Send them to *Model Airplane News*, Simple Programming, Air Age Publishing, 251 Danbury Rd., Wilton, CT 06897. See you next month.

**Addresses are listed alphabetically in the Index of Manufacturers (for page number, see table of contents).* ■

JETS OVER DELAND

(Continued from page 77)

their Sagittario sport models powered by the JPX-T240 turbine engine. When he isn't flying R/C jet models, David Gladwin is flying a Concorde all over the world.

BOB'S BIRDS

Besides flying Jeff Seymour's turbine-powered Big Red F-18, Bob Fiorenze had his own fleet of interesting planes that he flew every day of the meet. Though not new, his Yellow Aircraft F-14 Tomcat and F-18 Hornet are showstoppers in their own right, not to mention his much newer F-117 Stealth fighter/bomber from a prototype Yellow Aircraft Kit. All of these twin-engine beauties are powered by O.S. .91s turning Dynamax fan units from Tom Cook's JMP.

When Bob flew his magnificent all-black F-14 Tomcat, he did many wing swings during each flight so as to give everyone, especially the large crowd of spectators on Saturday, the opportunity of seeing how it looks in all attitudes of flight. The swept-wing position is particularly impressive during his high-speed, low flybys. He told me he must adjust the pitch trim during the wing swinging; I assume he does this via the mixing capabilities of his radio.

Never having seen his F-117 Stealth fighter/bomber fly, I was as anxious as I'm sure all the spectators were. Talk about strange-looking in the air! However, it flies fine. He made a perfect landing, and when he popped the drag chute, he received enthusiastic approval from all the many spectators. The chute is so effective that he can't taxi with it attached. He demonstrated this to the crowd, much to their amusement.

Speaking of taxiing, Bob, after a long roll-out after touchdown with his F-14, F-18 and the turbine F-18, would taxi back

(Continued on page 105)

HOW TO

Spiral Stability Design

by ANDY LENNON

Balancing dihedral angle and vertical tail area

Seahawk—.46-powered for wheels and floats.

TO ASSESS an existing model airplane's spiral stability—or lack of it—is easy. In level flight, at the model's normal cruising speed and at a reasonable altitude, put it in a 15- to 20-degree bank, then neutralize the controls and watch its behavior closely.

- **Spirally stable.** If it returns to normal level flight, upright, in turning up to 270 degrees of its circular path, it is spirally stable. The rapidity with which it rights itself is a measure of its degree of spiral stability.
- **Neutrally spirally stable.** If it continues to turn without the angle of bank increasing, it is neutrally spirally stable.
- **Spirally unstable.** If the angle of its bank slowly increases as it turns and its speed gradually increases in a descending spiral, it is spirally unstable. The rapidity with which it increases its bank angle is an index of its degree of instability.

LEVELS OF SPIRAL STABILITY

High spiral stability is needed for free-flight models (for obvious reasons) and for trainers. When a novice pilot gets into trouble, if his model has good spiral stability, he need only neutralize his controls and the model will, on its own, recover, provided it has enough altitude.

For sport models, a moderate degree of spiral stability is desirable. This applies also to flying boats, floatplanes, canards and particularly to rudder- and elevator-only models, both powered and gliders.

For pattern and aerobatic models, neutral stability or mild spiral instability is needed for good maneuverability. The spiral dive is slow to develop, so the expert pilot has no problem controlling the model.

A high degree of spiral instability is not desirable, nor is too much spiral stability, which inhibits maneuverability.

Testing the spiral stability of an existing model as noted above is hindsight. The old saw that, "Foresight, as good as hindsight, is a damn sight better" applies. We need a way to incorporate the desired degree of spiral stability in a design while it is still on the drawing board. This article addresses that need.

LATERAL AND DIRECTIONAL COUPLING

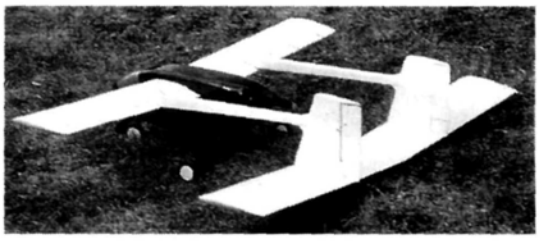
Spiral stability requires a balance between lateral (roll axis) and directional (yaw axis) forces. The extremes are:

- Large dihedral angles on the wing along with a small vertical tail area leads to "Dutch roll" (characterized by tail wagging coupled with a slight side-to-side roll) or even a stall-spin crash. The lateral forces are too high.
- A large vertical tail area along with little or no dihedral leads to sideslip; the large tail resists the slip, and a killer spiral ensues. The directional forces are too great.

Somewhere between these extremes lies the correct balance of lateral and directional forces that will produce the degree of spiral stability that suits the designer's performance objectives.

CARDBOARD PROFILE CLA DETERMINATION

My article on "Vertical Tail Design" (January 1994 issue) described Charles H. Grant's "Center of Lateral Area [CLA] Theory" and the profile method of deter-



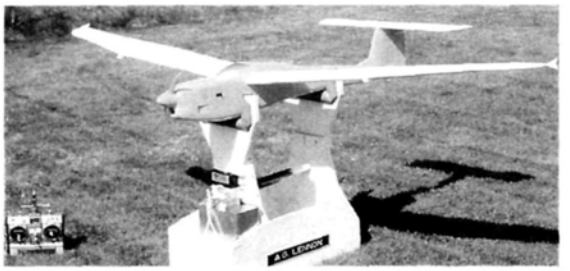
The Wasp is a .15-powered model—a tandem-wing biplane with 4 degrees of dihedral on each wing. The CLA was originally at 25 percent of the VTMA, but owing to doubts about the forward fuselage's impact on directional stability, the vertical tail area was increased to bring the CLA to 30 percent. The Wasp was spirally unstable and unpleasant to fly—just the opposite of the Skylark. Cutting off the fin tops to the rudder top levels (finotomy!) and adding small streamlined caps improved the spiral stability and the model's behavior. The CLA was then back to 25 percent of VTMA as originally planned.

mining the vertical tail area to achieve a balance between lateral and directional forces at the selected CLA location.

For those early, very stable, free-flight, gas-powered model aircraft, Grant recommended 4 degrees of dihedral and a CLA location of 20 to 22 percent of the vertical tail-moment arm, aft of the center of gravity (CG). This author has successfully used a modified version (for improved maneuverability) of Grant's procedure for many years.

BALANCE OF FORCES

Since spiral stability requires a balance between lateral and directional forces, i.e., a balance between the effects of dihedral angle and vertical tail surface area, the design procedure is to establish the lateral parameters (dihedral) first, and then to balance the directional parameters (vertical tail area) to match, at the chosen CLA position.



The Dove—a .15-powered glider—is a rudder-, elevator- and engine-controlled ship with moderate spiral stability.

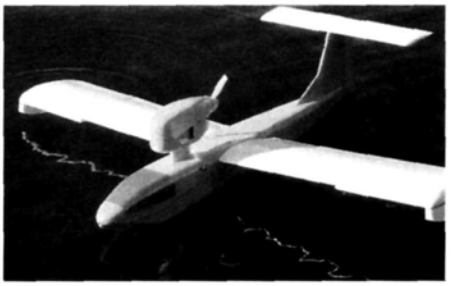
■ Lateral stability

• *Dihedral.* The wing's dihedral angle is a major contributor to lateral stability. See the chart: Suggested Dihedral Angles.

The relative positions of wing aerodynamic center (AC)—25 percent of the mean aerodynamic chord—and CG bear on the dihedral angle. A high wing enjoys some pendulum stability that's absent from mid- and shoulder-wing positions. With CG above the wing AC (as in a low-wing setting) there is pendulum instability, hence, the different dihedral degree figures.

• *Sweepback* acts like dihedral. In level flight, 2 to 3 degrees of sweepback are equivalent to 1 degree of dihedral. The dihedral effect increases both with angle of sweepback and lift coefficient and so, unlike normal dihedral, it increases with higher angles of attack.

Many pattern ships use tapered wings with straight-across trailing edges and sweptback leading edges. The angle of sweepback on the quarter-chord line is about 7 degrees on a wing of aspect ratio 6 and taper ratio (root to tip) of 1:0.6 and needs no dihedral. Without dihedral, there are no side areas projected by the wing ahead of the CLA (see "Vertical Tail Design," January '94 issue), and that reduces the vertical tail area needed.



Seagull III is a .46-powered flying boat with 3 degrees of dihedral. The large side areas of hull, nacelle, wing dihedral and wingtip floats ahead of the CLA demand a large vertical tail surface area for both stability and control. Determining that area using the profile method was easy. Its CLA was at 25 percent of the VTMA. It's maneuverable and sturdy and has excellent water performance.

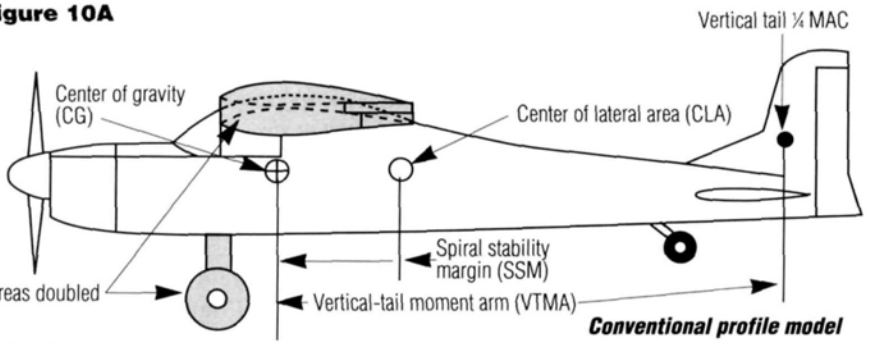
High sweepback angles on full-scale aircraft increase lateral stability to such an extent that negative dihedral (anhedral) is introduced to reduce lateral stability for better lateral control. The Lockheed Galaxy is an example.

• *Forward sweep.* Heavy forward sweep (20 degrees or more) is very destabilizing both laterally (in the roll axis) and directionally (in the yaw axis). When yawed, one wing advances and the other retreats; the centers of lift and drag of the advancing wing panel have reduced moment arms to the CG. The moment arms on the retreating panel are increased. The differential in drag moments increases the yaw; but the lift-moment differential causes a roll in a direction that's opposed by the yaw. The model will "corkscrew" and probably crash unless there is sufficient vertical tail area and/or vertical-tail moment arm to prevent the yaw.

This requires: 1) an area that's sufficient to bring the CLA to the 30 to 35 percent of vertical-tail moment arm (VTMA) position; 2) higher dihedral (as discussed above); and 3) a limit in the forward sweep to not more than 30 degrees measured on the quarter-chord line.

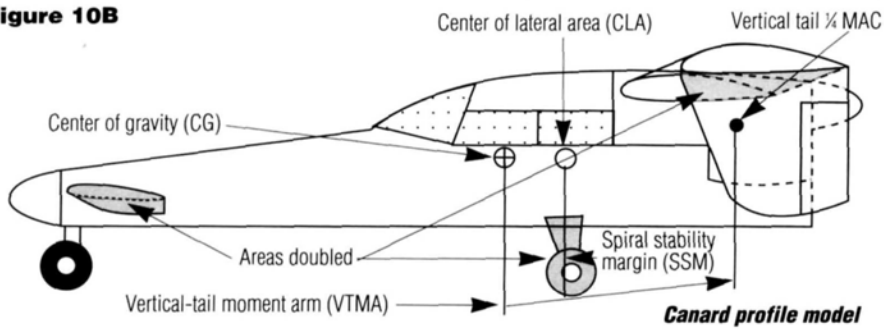
In addition, the model will be spirally unstable. The major advantage of forward sweep is that the wing stalls at the root first. Roll damping and effective aileron control continue to high angles of attack before the wingtips stall. This permits slow, high-angle-of-attack flight.

Figure 10A



Conventional profile model

Figure 10B



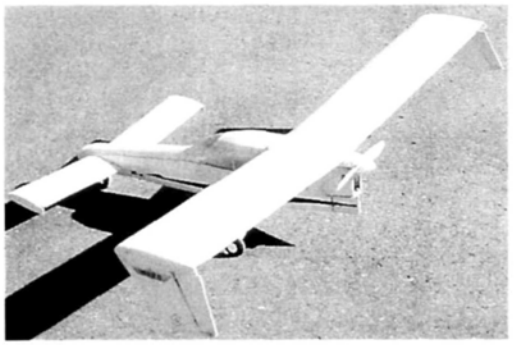
Canard profile model

■ Directional stability

The major factors are the amount of vertical tail area and its moment arm to the CG (i.e., vertical tail volume). The vertical-tail aspect ratio (AR), like that of a wing, is a contributing factor. Higher-AR vertical tails have steeper lift-curve slopes; they are therefore more sensitive, but stall at lower angles of attack. At high sideslip angles, a

high-AR vertical tail can stall, resulting in reduced control. A dorsal fin is recommended to overcome a lack of vertical-tail effectiveness at high angles of attack, such as when flaps are extended and at high sideslip angles.

Sweepback aids directional stability. When yawed, the advancing wing's centers of lift and drag have greater moment arms than those of the retreating wing. The drag-moment differential reduces the yaw, and the lift differential promotes a roll in the direction of the yaw.



Canada Goose—.35-powered canard.

• *Ailerons.* Good aileron design, with differential, reduces or eliminates aileron-induced adverse yaw. (See "Roll Control Design" in the August 1993 issue.)

• *CG location.* If the CG location of an existing model is moved forward from a position that's vertically in line with the wing's AC, it lengthens both the VTMA and the distance from CG to CLA (spiral stability margin or SSM). For example, the Swift has a VTMA of 24 inches, and with the CG under the wing's AC, the SSM is 25 percent of the VTMA, or 6 inches. Moving the CG forward 1 inch increases the VTMA to 25 inches, and the SSM becomes 7 inches, or 28 percent of the VTMA. This is enough to change the spiral stability from mildly positive to neutral.

If the CG is moved aft of the wing AC by 1 inch, both VTMA and SSM are reduced. For the Swift, the VTMA would be 23 inches and the SSM 5 inches, or a CLA location 21.7 percent aft of the CG. This is a very spirally stable location.

SUGGESTED DIHEDRAL ANGLES (DEGREES)

	With ailerons	Without ailerons or with forward sweep
High wing	2	5
Mid- or shoulder wing	3	6
Low wing	4	7

SPIRAL STABILITY MARGIN

Refer to Figures 10A and 10B. These static stability margins (SSMs) are suggested:

SSM as % of VTMA	
Super spiral stability	.22
Good spiral stability	.25
Neutral spiral stability	.28
Mild spiral instability	.30
Very spirally unstable	.33 and up

The increase in vertical tail area required to move the CLA aft is surprisingly large. For the Skylark, an increase in vertical tail area of 60 percent would have been needed to move the CLA aft from 22 percent to 30 percent of its vertical-tail moment arm—a distance of 1.65 inches.

CONCLUSION

The profile method for balancing lateral and directional factors, at the selected center of lateral area, is certainly not high-tech, but it's simple, effective and applicable to the great majority of conventional planform configurations.

The CG/CLA relationship and the SSM bear a remarkable resemblance to the CG-neutral point and static-margin concept in longitudinal stability considerations outlined in "CG location" in the April 1993 issue. Reviewing that article, the one on "Vertical Tail Design" (January '94 issue) and the material discussed here will well reward the model airplane designer. These techniques have worked well on a variety of designs built and flown by the author, and they're a good stepping-off point for further exploration of stability considerations in model design.

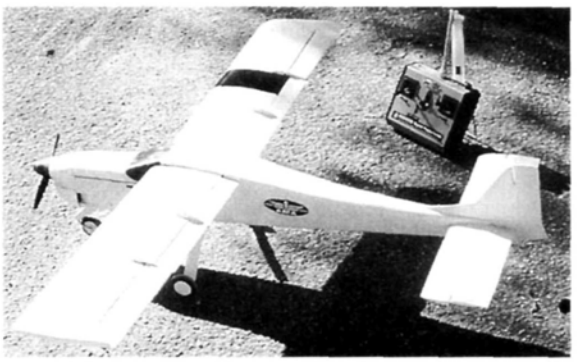
POSTSCRIPT

Some time after completing this article, while reading an old (1947) NACA Technical Note no. 868—"Summary of Lateral Control Research"—I found some very significant data (the data in NACA reports are timeless). Though expressed in general terms, without specifics, they reinforce the ideas expressed in this article and Grant's CLA theories.

• **Lateral stability.** High, positive, effective dihedral combined with weak directional stability, i.e., small vertical tail area, results in a large opposing action to any rolling motion (experienced with the Skylark) and can lead to a predominance of lateral oscillation, i.e., Dutch roll. Since the banking motion is opposed by the effect of the dihedral, that dihedral should be no larger than is necessary to meet other criteria.

• **Directional (weathercock) stability.** Modifications that increase directional stability, such as an increase in vertical tail area, permit greater roll rates to be obtained and make the performance of a given banking maneuver possible with decreased aileron deflection.

The effect on lateral maneuverability of changing the tail length while maintaining the same directional stability, i.e., the same tail volume, and thereby increasing the damping in yaw, is negligible.



The Skylark was a .15-powered model with 5 degrees of dihedral and a small vertical tail surface. Its CLA was at 22 percent of the VTMA behind the CG. It was so spirally stable that aileron control was sluggish; for turns, it was more responsive to rudder. Its high spiral stability reduced its maneuverability.

• **Adverse yaw.** The effects of adverse yawing moments on rolling velocity may be decreased by increasing directional stability, or by decreasing dihedral.

In Frank Zaic's 1935/36 yearbook, under the heading, "Determination of Rudder Area," a similar profile method is described. In it, the CLA is called the "directional center" (DC). It was intended for use on rubber-powered, free-flight models. Grant's procedure was a refinement of this early method. Thanks to Martin Simons for bringing this to my attention.

Those who are interested should read NACA Technical Note no. 1094 of 1946: "Experimental Determination of the Effects of Dihedral, Vertical Tail Area and Lift Coefficient on Lateral Stability and Control Characteristics." ■

MODEL AIRPLANE NEWS MAGAZINE
FIELD & BENCH REVIEW

PHOTOS BY MICHAEL CINGARI

Cyclic evolution

THE HIROBO* SHUTTLE helicopter series has been available in the U.S. for more than 11 years. The original Shuttle was one of the first helicopter designs to use molded-plastic side frames. It was also the first ARF collective-pitch helicopter available. The Shuttle was designed around a straightforward, easy-to-build, mechanical layout, and it exhibited excellent flight characteristics for a .30 machine. Anyone who wanted to build and fly an R/C helicopter found that it was very easy to achieve success with a Shuttle.

The new ZXX is now the top of the line in the fourth incarnation of the series of Hirobo Shuttle helicopters. It's unique because it comes with all the available options. The '94 Shuttle series also includes many new design features.

THE KIT

My kit was nicely packaged; all the parts and hardware had been individually bagged and numbered to make identifying them easy. The improved instruction manual has a parts breakdown and an exploded view for each assembly step. It also has notations indicating the differences in building the Z, ZX and ZXX models.

The sleek-looking canopy extends up to and around the swashplate. To dress up this new-generation Shuttle, a new set of colorful decals is included.

MAIN FRAMES

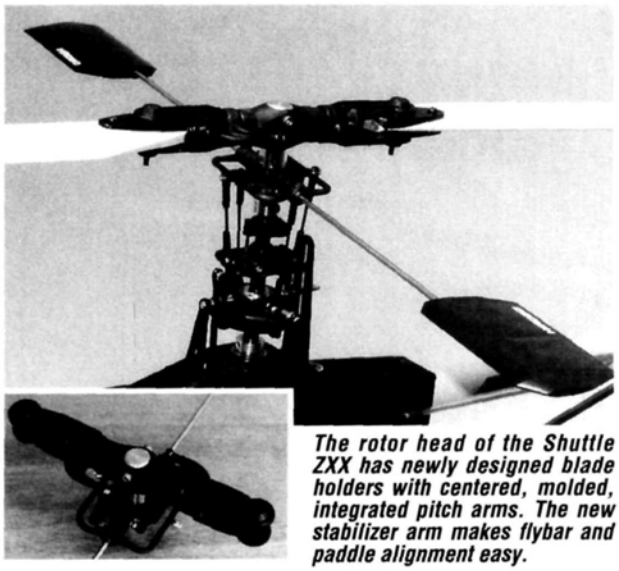
The core of the Shuttle ZXX's design improvement is its new main-frame sides that are molded of a ceramic material for increased strength and durability. If you'd like to improve your older Shuttle, you should upgrade the side frames first.

The radio switch has been moved to the upper right-hand side of the main-frame assembly. This places the switch on the side away from the muffler to protect it from oil and other contaminants. A hole for the remote glow driver is

by MICHAEL CINGARI

HIROBO

Shuttle ZXX



The rotor head of the Shuttle ZXX has newly designed blade holders with centered, molded, integrated pitch arms. The new stabilizer arm makes flybar and paddle alignment easy.

directly below this switch. A large opening in each side of the main frames now makes it possible to replace the glow plug without inverting the machine.

The main-frame assembly now has a channel molded in line with the carburetor that allows you to remove and install the engine without removing the carburetor. The redesigned main ball-bearing holders are stronger and more massive; this helps to maintain the position of the main shaft and clutch bearing. An added feature of the new frame sides is that any of the main- or second-shaft bearings can be removed or replaced without separating the main frames.

The servo tray is higher to clear the new 250cc fuel tank, which now has external plumbing that moves the fuel line away from the glow-plug area. A molded vent nipple is on the upper left rear corner of the fuel tank. If you adapt the new frames to your pre-'94 Shuttle, you'll need to use the lower holes that have been drilled along the front edges of the frames. This will allow you to use your old servo tray and fuel tank.

SPECIFICATIONS

Weight: 5.8 lb.
Gear ratio: engine to main—9.6:1
main to tail—1:5.5
Engine: .30
Main rotor diameter: 48.8 in.
Radio: 5-channel heli
Gyro: recommended
List price: $859 (assembled with Enya SS .35); $619 (kit).

HITS
- Excellent flight characteristics.
- Simple to build and set up.
- Kit includes all upgrades.
- Ball bearings located throughout the helicopter.
- Comes with muffler.

MISSES
- Doesn't include starter shaft.
- Rotor blades aren't symmetrical.

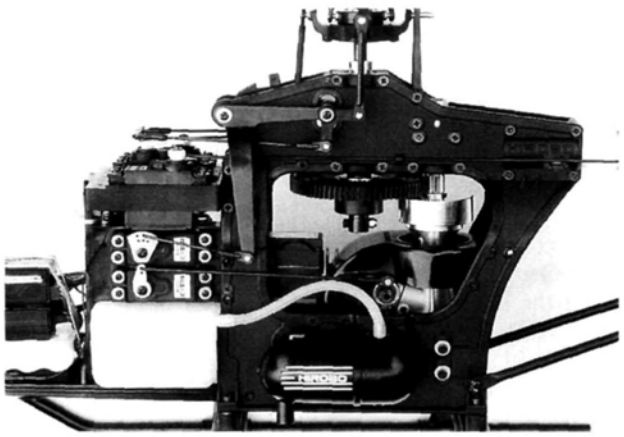
POWER TRAIN

A newly designed top starting system is standard on the ZXX. A machined-aluminum clutch bell is dual-bearing-supported in the frame and one-bearing-supported in the clutch shoe. The lower pinion bearing is now the same size as the bearings that are used on the main shaft. This new system has a second bearing between the main frames to ensure perfect alignment of the engine and drive-train system. A metal starter shaft passes directly through the center of the clutch bell, and the bottom of this shaft engages a one-way bearing in the center of the clutch shoe. A hex-socket is mounted to the top of the starter shaft and completes the vertical starter-shaft system. This system requires a starting-shaft adapter, which isn't included because Hirobo didn't want to charge you for something you might already have.

To operate this system, insert the starting shaft in the cup, and engage the starter. When the engine starts, the starter shaft will stop spinning; just remove the starter extension wand. The system is very safe and simple.

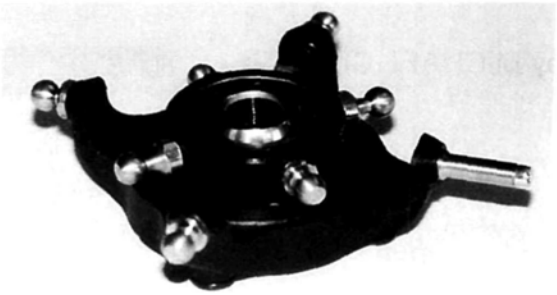
I power the ZXX with an Enya* SS .35 Heli engine. This reliable, powerful engine has an easy-to-adjust, two-needle carburetor.

The ZXX has a very simple mechanical layout that can be assembled quickly. All the components are accessible.



This aluminum muffler is included in the ZXX kit. The new 250cc fuel tank, with molded vent line, provides enough fuel for more than 20 minutes of flying time.

The ZXX has a newly designed two-piece fan assembly. The new, highly efficient cooling fan is molded of plastic, and it's attached to the machined fan hub with four countersunk machine screws. The fan assembly is self-aligning and can be used in most engines by using the correct tapered collet. This system runs true and vibration-free while providing improved cooling.



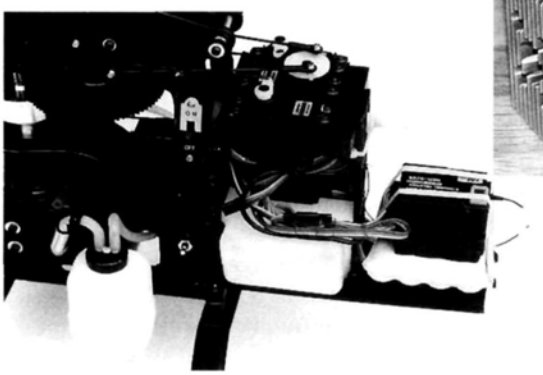
One of the nicest features of the ZXX is this high-precisio aluminum/plastic swashplate. Note the stainless-stee hardware.

FLIGHT PERFORMANCE

When the new ZXX lifted off, the first thing I noticed was that the control system was very tight and accurate. All the control-system inputs, no matter how small, are precise and exact. The helicopter's cyclic system is responsive, and it returns to center perfectly after each control input. This alone was a very noticeable improvement on any other Shuttle that I've flown. Tail-rotor response and centering precision were also excellent.

In forward flight, the ZXX behaves well and goes exactly where it's pointed. The model tracks very well at all speeds and requires only a small amount of stunt trim to keep it on track. The ZXX doesn't exhibit any nose-up pitching when the rotor disk is heavily loaded at the bottom of a loop.

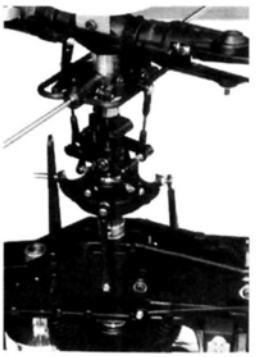
The helicopter is a potent freestyle performer with the head speed cranked up to 1,800rpm. The semisymmetrical main rotor blades weigh 75 grams. They hover and fly well, but they're a bit on the light side and lack the inertia required to execute no-wind autorotations. For pilots with a higher level of proficiency, a set of fully symmetrical rotor blades that weigh around 100 grams would be a nice improvement.



The radio switch, the remote glow driver and the glow-plug access hole can be seen from the right side of the Shuttle ZXX.

CONTROL SYSTEM

One of this kit's nicest features s its newly designed swash-late that has an injection-nolded-nylon outer ring and a nachined-aluminum inner ing. Stainless-steel balls are sed throughout. The swash-late is supported by a slotted adius arm that's between the ide frames to provide a very ght, precise control system. he elevator lever is on the xterior of the side frames. his makes hookup and adjustment easy and contributes to the overall tightness of the control system.

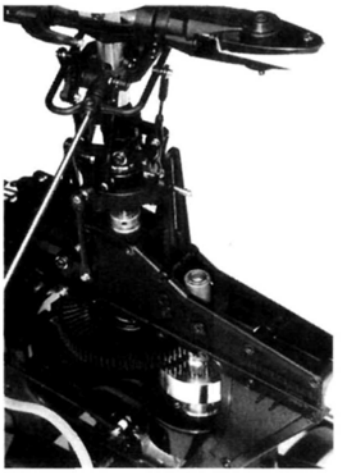


From the top down, you can see the new blade grips, the 360-degree stabilizer arm, the adjustable linkages, the swashplate and the radius arm.

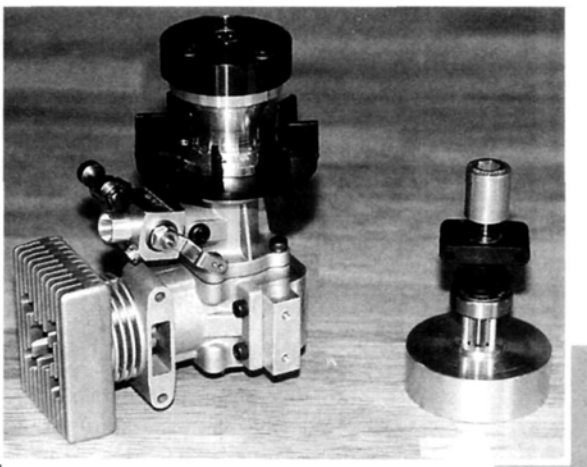
ROTOR HEAD

The ZXX has newly designed blade holders and pitch-control arms that are molded as one piece. The old, offset, metal arms could be bent easily, and that caused tracking problems. The new blade-grip design should completely eliminate this problem.

The ZXX has thrust bearings and pivot bearings in these new blade holders.



The top starting system and the control-system parts make the ZXX an excellent machine.



The new top starting system, the machined-aluminum clutch bell, the steel clutch, the machined-aluminum fan hub and the Enya SS .35 Heli engine make a durable drive-train system.

Until now, this feature has been reserved for .60 machines, which cost much more. The thrust bearings allow the ZXX to use heavier main rotor blades and run at a higher main-rotor speed. Thrust bearings carry the thrust load normally handled by the pivot bearings. These thrust bearings improve the tracking and increase the performance of the Shuttle ZXX. The molded pitch arms are connected to the mixing arms by a new set of adjustable pitch-control rods. These, as well as the rest of the links on the rotor head, are now fully adjustable. A new, 360-degree, in-line stabilizer arm makes flybar and paddle alignment easy.

TAIL ROTOR

The Shuttle's tail rotor is driven by a cogged drive belt. This simple system works very well and requires no maintenance. The tail-rotor control pushrod has been replaced by a larger, 1.7mm control rod that has a Z-bend on the servo end and a ball link on the tail-pitch lever. This stiffer rod greatly enhances the precision and centering of the tail-rotor control system. The ball link also makes adjustments much easier. The tail-rotor blades have been lengthened slightly for improved tail-rotor response.

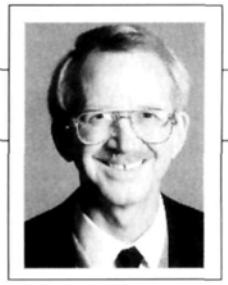
CONCLUSION

The Shuttle ZXX is a much-improved version of an already proven machine. The ZXX costs over $100 more than the Shuttle ZX, but remember, this price includes more than $170 in upgrades. Hirobo has listened to heli fliers and has produced a machine that doesn't require any additional parts to qualify as a high-performance helicopter. This is a super .30 helicopter that will satisfy demanding novices as well as expert fliers.

To improve precision, the tail-rotor pushrod has been enlarged to 1.7mm and includes a ball link for easy adjustment.

**Addresses are listed in the Index of Manufacturers (for page number, see table of contents).* ■

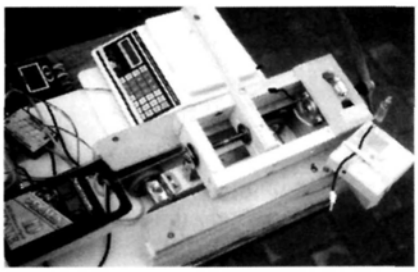
ELECTRICS



MITCH POLING

MOTOR TEST STAND

IN THE FEBRUARY issue, I discussed gearing and how you can get more power at higher efficiency. Part of that discussion used some motor theory to get the motor power output and efficiency. You do not have to use motor theory to get output power and efficiency, perhaps to the relief of many! Direct measurement works very well, though the test setup can be a challenge. The



Motor test setup: 12V halogen bulb, motor frame with torque arm, digital balance and thrust trolley below motor frame.

test setup I use measures thrust, torque, rpm, voltage and amperage. The torque and rpm measurements will give you the output watts; voltage and current will give you input watts. From these, you can get the efficiency of a motor. The formula for converting torque to watts is: watts = 1.03 x kilograms x meters x rpm. We will see where these measurements come from a little later in the column.

You can get propeller curves if a propeller is used as the motor load. Propeller curves are wonderful; once you have them, you can determine the thrust and power output of a motor from only one measurement: rpm. As far as I know, these curves are not available from the manufacturers; you have to do them for yourself.

I use APC* propellers, so I am working on curves for those propellers. The curves included with this column are for 7x3, 7x4, 8x4 and 8x6 APC propellers in the 2,000 to 20,000rpm range. The curves are from measured values on my motor test stand. Power measurements below 10 watts are hard to measure on my setup; power above 250 watts exceeds the mechanical limits of the test bench. With these limitations in mind, you can still use the curves for quite a variety of situations. For example, you can see from the graphs that at 12,000rpm, an APC 8x4 prop absorbs a motor output of about 125 watts and produces a thrust of about 24 ounces. Isn't that quick and simple? It would be great to have such curves from the propeller manufacturers. A tachometer would be all that is needed to get very complete information on your electric power performance. Perhaps someday!

THE MOTOR TESTER

The motor test setup is shown in the sketches and the photos. I started out with a pair of roller skates that I bought cheap at a garage sale. The wheels, ball bearings and axles from one skate were used to make a test trolley. A Normark* digital fish scale hooked up to the trolley measures the thrust in ounces. Flanges and side fences keep the trolley in place while the motor is running; otherwise, it can swing to the sides or lift off the test board. The trolley has two steel L-brackets that support a horizontal shaft (skate axle). The threaded

Bob Ortman's scale Northrop N9M at the PSEMF Electric Fly. The flying wing is powered by two Astro FA1 05s running on 16 cells. All-up weight is 6½ pounds. Very impressive flights!

ends of the axle are bolted into the holes in the L-brackets. A wooden frame with two skate ball bearings is mounted on the horizontal shaft. The frame can tip from side to side. An arm goes across the frame, and a wood screw serves as a contact point on the weighing pan for the torque measurements. The distance (moment arm) from the center of the shaft to the contact point is 16.5 centimeters. There is nothing special about the length of this torque arm; 16.5 centimeters just happened to be handy. A digital balance that measures in 1-gram steps up to 2,000 grams measures the torque force.

The wooden frame has two arms that support a plywood motor-mount plate. The plate has two holes in it. A 2¼-inch-diameter hose clamp (this size will accommodate most motors) is looped though the holes. Changing motors on the test stand is easy: just loosen the hose clamp, slip in the motor, and tighten the clamp. There are many ways to accomplish the same setup; feel free to try

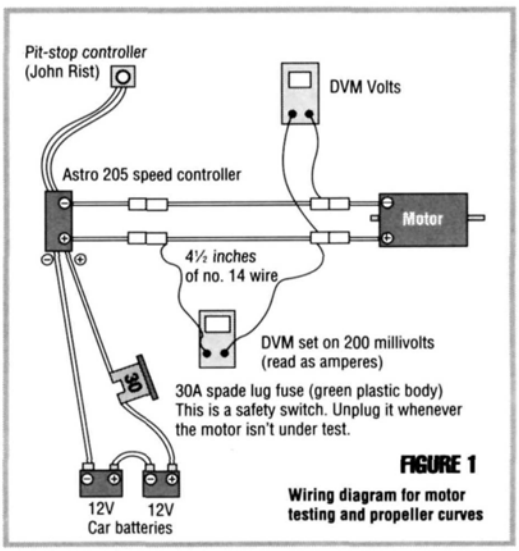


FIGURE 1
Wiring diagram for motor testing and propeller curves

IN-FLIGHT MEASURING

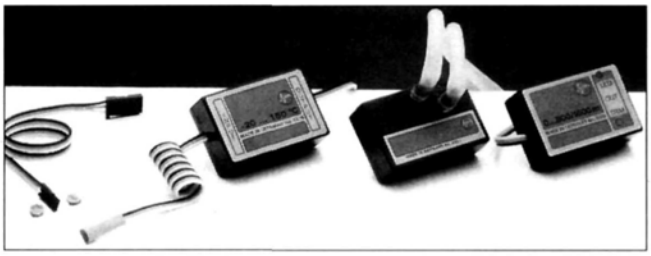
Aero-naut* showed a mock-up of their Digimeter mc Memory last year at the Nuremberg Toy Fair. This aroused a lot of interest, but development has been slow. Aero-naut showed their latest version of the mc Memory at this year's Toy Fair, and they were promising production by spring of 1994. When this memory module does become available, it will be a valuable tool for measuring and maximizing model aircraft performance. Interestingly, the current-measuring input is just what I have been using for years. It is a 4.5-inch length of no. 14 wire, which plugs into the plus line of the power system. The tachometer electronics are included in the module, and the rpm sensing element has about an 18-inch cable. The temperature probe is also a cable, with the temperature electronics in the module. The altitude sensor is built into the module.

The Aero-naut onboard data module.

The module is powered by the receiver battery and can display current to within 100 milliamperes, voltage to 10 millivolts, rpm to 1rpm, temperature to 0.1 degree Celsius, altitude to 1 meter and flight time to 1 second. These values can be recorded nine times in one flight, using one channel of radio control to turn the measurement on and off. A 10th reading stores the maximum values of each measurement. The data is read from a large, 10-digit LCD display that is part of the module. No information on the size of the module was given; the prototype I saw was about ½x2½x1½ inches, and it looked as if it weighed about 3 ounces. This is a very compact and convenient module. I want one! It would do very well as a test-stand measuring system as well; it would eliminate the very awkward "look and write" method I use now. It does lack a flight-speed sensor, but the tachometer could measure the flight speed. Mount a small, free-spinning prop on the wing, calibrate its rpm for speed, and you have a flight-speed sensor. The suggested retail price for the Digimeter mc Memory is DM 399 ($250). Check with Aero-naut for availability.

The Modis data collection and storage processor from Robbe is a sophisticated instrument.

Robbe Model Sport* showed their onboard computer at the Toy Fair, and it is available now. It is similar in appearance to the Aero-naut prototype unit, with a six-digit LCD display built in—size: 2x1.1x.9 inches; weight: 1.1 ounces. It can store three types of data up to nine times during a flight. It can run from the receiver battery and uses only 15 milliamperes of current. The onboard computer does not contain the electronics for the sensors. The sensor boxes are about the size of a large servo and include the sensor electronics. Sensors are available for altitude up to 1,600 meters; rpm up to 30,000; speed up to 400 km/hour; temperature up to 150 degrees Celsius; voltage up to 50 volts; and current up to 75 amperes. The onboard computer is listed at DM 259 ($160); the rpm sensor is DM 30 ($20); the voltage sensor is DM 69 ($43); the temperature sensor is DM 65 ($41); the altitude sensor is DM 165 ($103); and the current sensor is DM 99 ($62).



The temperature, speed and altitude sensors for the Robbe Modis and onboard computer are approximately the size of standard servos.

Robbe takes the in-flight data storage concept one step further with their Modis unit. This is a professional unit that can store data for up to six sensors simultaneously, with scanning rates of 1, 2, 10 and 500 times per second per sensor. The Modis has a large memory, and at 1Hz per second, it can store up to 55 minutes of data for all six sensors. The results are then read into a PC or laptop computer and evaluated and displayed using the software included with the Modis. This is serious business! The sensors are the same as those listed for the onboard computer. The Modis box is 3x1.9x1 inches and weighs 2.5 ounces. Holger Krischick has used the Modis to optimize his high-speed electric boats and now holds the European record in the F1E class. The Modis unit costs DM 549 ($343); the cost of the sensors is additional and is the same as for the onboard computer.

The Robbe onboard computer.

The average modeler does not have to worry about measuring all the parameters of model flight. The good old "Throw it in the air and have fun" rule is the most important one for all of us! On the other hand, the new measuring capabilities will benefit us all in the future, as designers, manufacturers and competition fliers use these systems to help produce models that perform better than ever before. It will be fun!

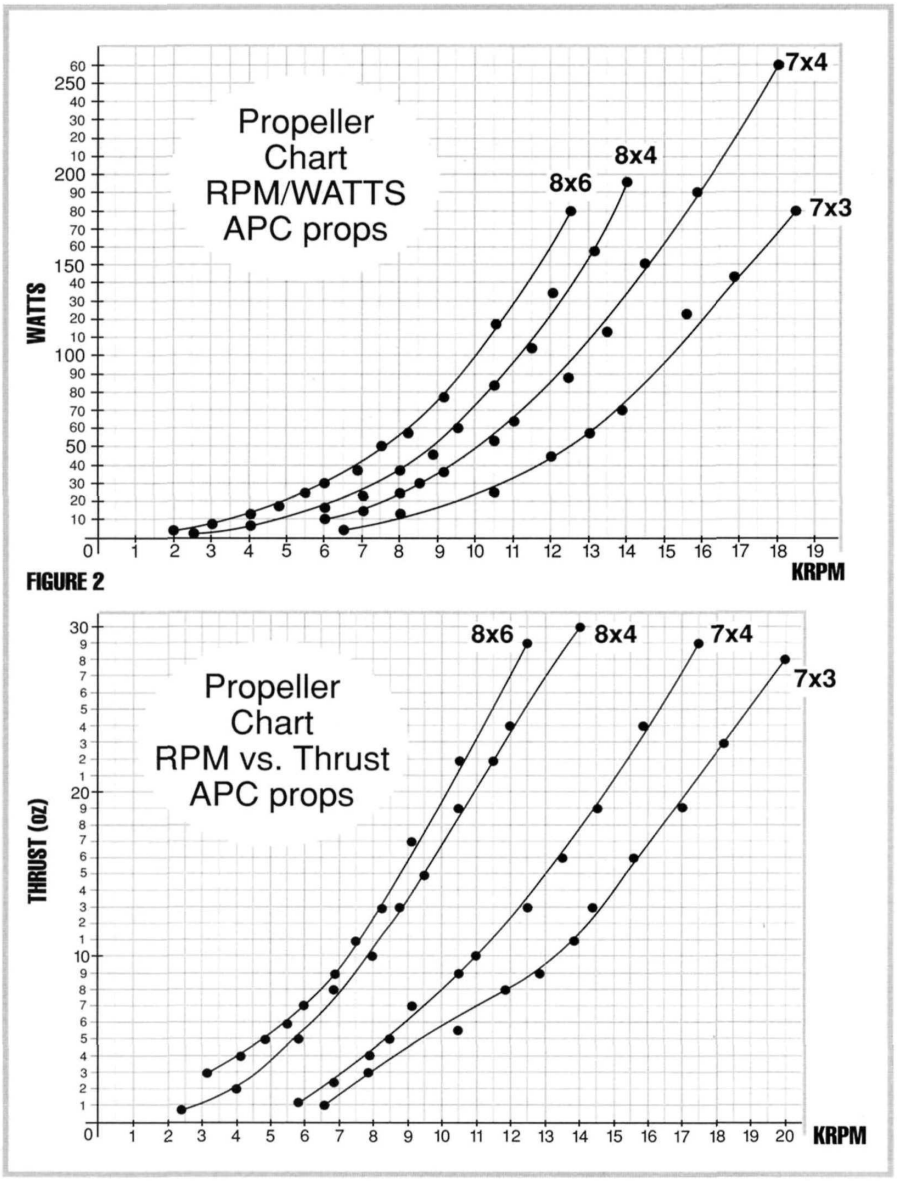


FIGURE 2

your own ideas. If thrust is not measured, the trolley can be omitted. That would make the test setup very simple.

Two digital voltmeters (DVM) with 3½-digit displays are used—one for voltage, one for current. The current is measured anywhere in the power wiring by the millivolt drop through a 4½-inch length of no. 14 wire, as shown in Figure 1. This length of wire will show one millivolt for each ampere going through the wire. Use the 200mV scale of the DVM. You should calibrate the shunt with another ammeter in series with the shunt. Many DVMs have a 10A setting that is fine for this. Adjust the shunt by trimming the length of the wire. The voltage should be measured at the motor terminals, as shown in Figure 1. Rpm are measured by a Royal* digital optical tachometer, which can display three digits. I work in the basement, and any line AC-operated lights will give a 60-cycle (3,600rpm) reading on the tachometer. I use a 20W, 12V DC halogen bulb connected to one of the 12V batteries for light. This is enough light for reading all the digital displays, and it eliminates the 60-cycle interference.

None of the measuring instruments has to be digital. The data (and results) are limited to three digits because of the 3½-digit displays used in digital instruments. Analog meters and spring-scale balances can be read to that much precision also.

The motor power is supplied by an Astro* 205 high-rate speed controller and two 12V car batteries in series (24 volts). I plan to use three car batteries for 36 volts after I build a test stand that can handle over 250 watts. Then I can test larger motors, such as the Astro 25, 40 and 60. The positive power line has a 30A automotive spade fuse in it for a safety switch. I always unplug the fuse whenever the motor is not in action. Be safe, not sorry! At first I ran the speed controller with my radio-control equipment, but this was quite awkward. I now use a servo controller ("pit-stop radio") that does the job very well. In the August 1992 issue of *Radio Control Car Action*, John Rist tells us how to build our own pit-stop radio. It is a very simple do-it-yourself project. You can order the circuit board from John. I bought my servo controller at a hobby store that sells off-road car equipment.

There you have it—a simple setup for testing motors. It took me about four hours to build it and about four hours more to get the measuring equipment installed. Have fun!

USING THE RESULTS

Here'a a typical motor run: 8x4 APC prop; Astro 15 motor; 14,000rpm; pull (thrust)—30 ounces; torque force—85 grams; input volts—13.16; amperes—29.0. The temperature was 60 degrees Fahrenheit; 30½ inches mercury pressure; and 65 percent humidity. The input power is: V x I = 13.16 x 29.0 = 382 watts. Output power is: 1.03 x meters x kilograms x rpm =1.03 x 0.165 x 0.085 x 14,000 = 202 watts. Efficiency is 53 percent. Repeat this for 10 to 12 rpm values, and you have a propeller curve. Once you have that, you can skip thrust measuring and power calculations whenever you use that propeller. Do note, I have said nothing about the effects of atmospheric pressure, temperature and humidity (density altitude). If

you fly in temperature or pressure extremes, you may want to run curves for each of the temperature and/or pressure situations you may encounter. An example would be flying in the winter at freezing temperatures as compared with flying in midsummer at over 100 degrees, or flying at the seashore as compared with flying in Denver. I am interested in propeller curves taken either at higher altitude or temperature extremes. I would be happy to do some data trading. Enjoy!

Bob Benjamin, well-known writer/designer/painter of aircraft, shows his Astro Porterfield to a young lady at the Boeing Hawks/Puget Sound EMF Electric Fly In.

FUN FLYS AND CONTESTS

Speaking of performance, Mr. Azarr—the event coordinator for the Competition Fun Fly Nationals—has a challenge for electric fliers! The National Competition Fun Fly Association (NCFFA) will award a special prize for the highest-placing electric aircraft at the Competition Fun Fly Nationals Shootout at Indy '94, Labor Day weekend, September 3 to 4. The electrics would fly in competition with gas; as Azarr says, "Fly with the best and show us watts up!" The NCFFA likes experimenters; its purpose is to promote competition fun-fly, electric-powered flight and model aviation in general. I think this is a challenge well worth trying. Many of the fun-fly planes have been converted to electric, and they are often seen at the KRC meet but, apparently, none have been entered in competition. For more details, contact Mr. Azarr at 1750 Lundgren Rd., New Carlisle, OH 45344; (513) 849-0411.

The July 1993 issue of *Model Airplane News* published the construction article of Russ Pribanic's WATT?. John Mountjoy has reported on fun-fly electric conversions in *R/C Report*, and their April 1992 issue had an article by Sam Buchanan on his electric conversion of the Stickit IV. Sam used a geared Astro 25 on 14 1500mAh cells and an Astro 205 speed controller. Flying weight was 4.75 pounds. The Stickit is capable of a nearly vertical climb with a Zinger* 14x7 prop, and flight times are 6 to 8 minutes.

For competition, much lighter cells can be used. Most events take less than a minute to do, so 900 or 1000mAh Sanyo SCR cells would do the job very nicely and save nearly a pound. I would experiment with other props and motors, too, such as the Model Electronics* 9-cell power unit I described in the February column. Go for it!

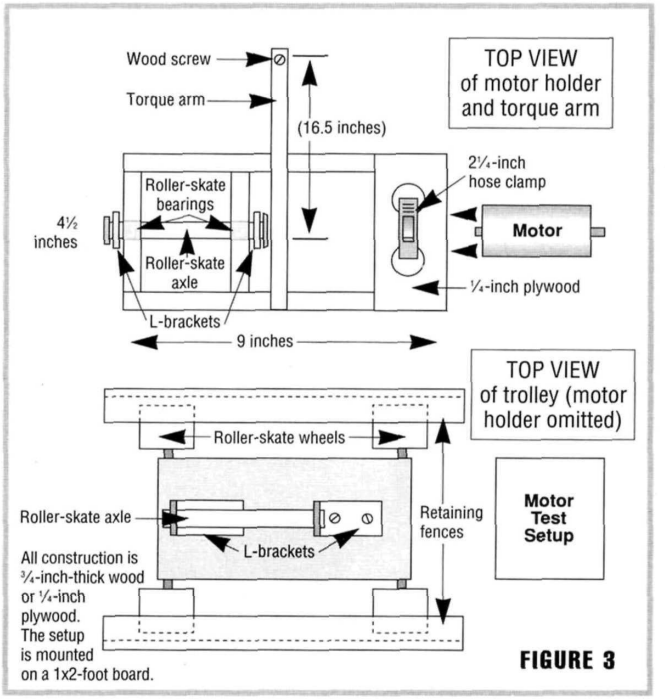


FIGURE 3

The Boeing Hawks will have their 12th annual Puget Sound Electric Model Flyers Electric Fly In, June 25 to 26. I remember the first one; there were about a dozen of us! The event has since grown to 40 or more participants and over 100 planes, coming from Washington, Oregon, California and British Columbia. This is a weekend for fun, with lots of relaxed flying, awards for participants and trophies for three events: AMA 609, Best Scale and Best Multi Motor. AMA 609 is a six-minute precision flying event; any type of plane is qualified to enter. For information on frequencies and registration, contact Mike Kometz, 18911 25th S.E., Bothell, WA 98102; (206) 481-1844, or Bernard Cawley, 29838 48th Ave. S., Auburn, WA, 98001; (206) 839-9157. See you there!

Last but not least, I have a couple of "uh-oh's." I mistakenly wrote the exponent of 10 as -11 in the formula for thrust in the February column. The exponent should have been 10. Now you can get 17 ounces of thrust instead of 1.7! I managed to repeat the same error on line 4490 in some of the BASIC programs I sent out, and somehow the term "P(I)" sneaked in as well. The P and the parentheses should be omitted; that term should be just a simple I. The thrust values will make more sense with I! Thanks to the readers who caught these errors and let me know! You can write to me at 601 Medical Squadron, PSC 10, Box 1908, APO AE 09130. All it takes is a first-class, 29-cent stamp. Till next time, fly high with electrics!

**Addresses are listed alphabetically in the Index of Manufacturers (for page number, see table of contents).* ■

GOLDEN AGE OF R/C

HAL DeBOLT

PAPPY'S MAILBAG

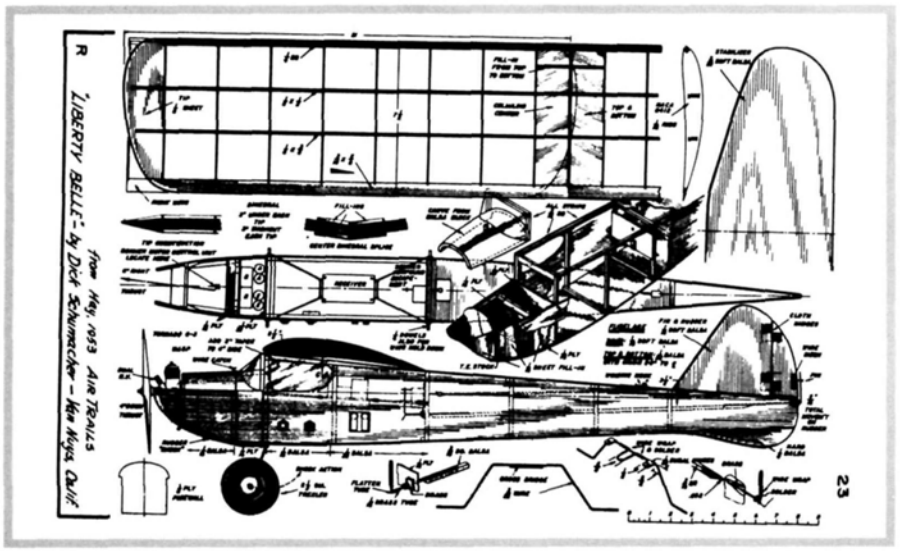
THIS IS YOUR OT R/C place; many of you have interesting input, so let's get at it! I appreciate all your anecdotes—the other readers do, too.

Bill DeJarnette of Satellite Beach, FL, writes that he enjoys "Golden Age"; his show-and-tell is a very well-done replica of the Top Flite Little Rascal. Back in the '60s, there was an R/C movement that seemed determined to see how small a successful model could be. Ken Willard got into the phase pretty heavily (he did very well, too), and the Little Rascal came from his fertile mind.

In 1963, Bill had considerable success with his first Little Rascal, and the memory lingered. The original used an F&M Pioneer receiver with an O.S. mini compound escapement that provided rudder and "kick-up" elevator controls. It was powered by a Cox .010 engine, and the entire assembly weighed only 7 ounces! "Kick up" was a nickname for the combo in which the main compound escapement operated a standard S-N escapement (on the elevator) with the third position of the compound. Obviously, it was physically impossible to produce a second set of three pulses that would be required to activate the S-N's second position. So the first position of the S-N was set up for up-elevator, and you can bet we were happy to have that!

In 1954, while serving in the Air Force, Don Butman launches his Liberty Belle at a Japanese baseball field. Note the curious onlookers.

Bill recently built a replica of his Little Rascal. Thanks to John Pond, he was able to obtain plans. His replica uses a modern Futaba radio with three S-133 servos that provide rudder, engine and complete elevator control. A Cox .020 engine provides twice the power of the original. His replica weighs 10 ounces and, of course, it's much more maneuverable. Bill says that it's a fantastic flier.



This is a Franz Zaic drawing of Dick Schumacher's Liberty Belle. It was a popular ½A model in the early '50s that was successfully built and flown by many.

Bill also says that he especially enjoyed the October '93 "Golden Age" because in the '60s, he flew the F&M systems with Jim Simpson. Everything I hear about those early F&M systems is good.

NEWS FROM TEXAS

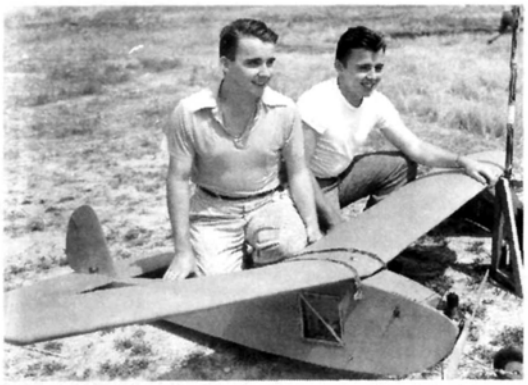
"Stoney" Stoneman of Garland, TX, checked in. He couldn't believe it when he found a new-in-box Midwest T-Craft kit at a garage sale. Stoney thought he might have an antique, but I had to inform him that it was from the early '80s.

The T-Craft design pleased me very much. Actually, it was a takeoff of the early "Equalizer"—a smaller '50s "Over and Under." Is anything ever really new?

When I designed the T-Craft, I had envisioned a fully aerobatic, scale model that would handle like a trainer and have the utility of a cabin-style craft. I sure was happy to hit the nail on the head; the model was simple to maintain, it practically flew itself, and it was a good match for most pattern designs. Want an enjoyable Sunday flier? *Model Airplane News* has plans (FSP04801, $11).

Otherwise, Stoney finally found the cause of the demise of his OT Ken-Hi Buzzer'd. At a decent altitude, all by itself, the Buzz had suddenly developed "elevatoritis" as it flew from inside to outside loops and finally straight in. The plastic

R/C PLANE EVOLUTION—'37 TO '40



Walt and Bill Good with Big Guff at the '40 Nats. The 8-foot-span model was powered by a Brown Jr.

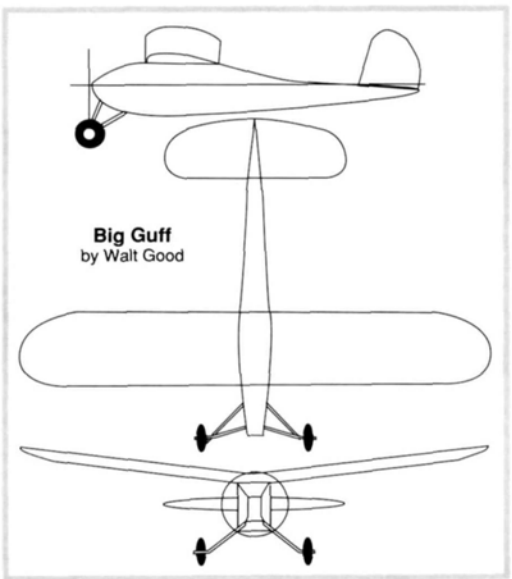
In 1937, the first official R/C Nats was held in Detroit, MI. Out of the half a dozen or so entrants, Chet Lanzo was the only pilot who recorded an official flight. Thus, Chet won with a converted free-flight model that featured a stick-style fuselage, a parasol wing and rudder only.

That set the stage for the next few years; converted free-flight models or variations of free-flight designs dominated R/C. The large free-flight models of the day (a lot of lift was required to carry the heavy equipment), such as the Super Buccaneer, Custom Cavalier and similar designs, were popular choices.

The Good brothers established a trend of sorts with their perennial winner, the "Big Guff." Apparently, the boys had been free-flight modelers and had developed a successful design based on Kovel-Grant parameters that they labeled the "Guff." When they needed a model that could carry heavy radio equipment, a logical and practical approach was to enlarge the successful Guff; thus, the Big Guff was born.

The Good brothers won consecutive Nats with the Big Guff. It's hard to imagine anything slower than that plane. I recall watching Walt make a landing approach from what seemed to be a mile above the ground and a mile out. (In those early days, it was very important to land close to the takeoff area to get a good score. When was the last time *you* landed off the field?) After about 10 minutes, with the Big Guff still not down, I thought: this is R/C? Maybe so, but there sure was a long way to go!

Defying the norm for early R/C, the Big Guff survived when most others did not. It now rests in the Smithsonian Institution as an example of early R/C. Walt still flies R/C!



A three-view of the Big Guff.

control horn had split where the arm was joined to the mounting lug—a most unlikely place! The horn was old stock, and the plane was a docile flier. Stoney thinks that the plastic had deteriorated with age. He threw away his supply of plastic parts and will now buy as needed. Perhaps that's good advice for us all.

FLYING IN THE FORCE

The armed forces have done model aviation a favor over the years by providing modeling facilities at many bases—especially overseas. Do you recall Air Force teams attending the Nats? I wonder if they still do? I know that the first Navy hobby shop at Patuxent Air Test Center made a fine impression on the GIs and the powers that be. In the early '60s when I visited Japan, I was mightily impressed by the extent of the Far-East Pacific Air Command modeling program. There were many fine hobby shops with hundreds of Air Force types involved in all phases of modeling. (Model aviation used to have so much help from major outside sources. Where has it all gone, AMA?)

All this was brought on by a fine letter from Donald Butman of Woodland Hills, CA, who tells us of his initiation into R/C in the '50s at Haneda AFB in Japan. Although flying on the base was restricted to control line, he and a buddy flew their Liberty Belle and Live Wire at a Japanese baseball field.

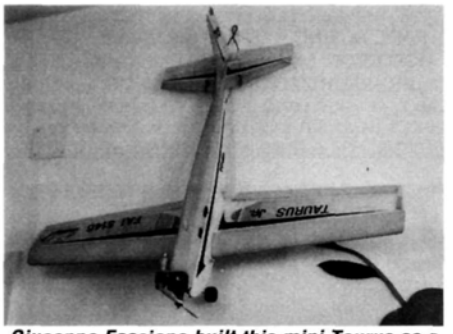
Don's Liberty was typical of the times—.049-powered and guided by a Lorenz "two-tuber" with a Sigma relay and a Bonner escapement. He closes by recalling costs: his O.S. .049 listed at $3, and the Green Label Blue Blazer fuel came from the USA at 85 cents a *quart!* The Japanese fuel smelled like shoe polish and was packaged in beer cans. Does anyone recall what caused that shoe-polish smell? I seem to remember that we used the chemical as a "retarder" in control-line speed fuel.

LIVE-WIRE REPORT

Herman Chairez of San Bernadino, CA, tells us that when he was a junior in high school, his first R/C model was a LW Trainer. It was followed by a Rebel, a Champ, a P-Shooter, etc.; Herman has fond memories of flying them. The systems he has used range from escapements to a Galloping Ghost to reeds. He even has a Bonner prop that's still operational! Best of all, he says that he would be pleased to

copy LW Rebel plans for anyone who wants them! Contact him at 3804 Bronson St., San Bernardino, CA 92405. Another source of most of the LW plans is Fran Ptaskiewitz, 23 Marlee Dr., Tonawanda, NY 14150.

John Wolf of Belle Vernon, PA, found an ancient single-channel Orbit system in pristine condition at a flea market. Now, he and flying buddy Ben Jones would like to fly it to show all the Johnny-come-latelies how it was. They don't have instructions for the Orbit, however; can anyone assist them? Any help sure would be appreciated! Contact John at RD #1, Box 248A, Belle Vernon, PA 15012.



Giuseppe Fascione built this mini Taurus as a tribute to Ed Kazmirski.

VIVA ITALIA!

And now from overseas—Rome, Italy, to be exact—Giuseppe Fascione sends a nice letter and photos of his mini Taurus. Giuseppe has a penchant for building "small-step" versions of OT R/C planes; the Taurus is his latest model.

His 42-inch-span mini Taurus uses a full-house Futaba system with S-133 servos and is powered by a SuperTigre X 11 for a flying weight of 30 ounces. Giuseppe says that the .11 can be swapped for a .15 if more power is desired. He says that the Taurus is his tribute to world champ and designer Ed "ol' Kaz" Kazmirski. His next project will be a full-size Kazmirski Orion from *Model Airplane News* plans (FSP06601, $10.50). Giuseppe is obviously a Kaz fan! It's always great to know that OT R/C is alive and well outside the USA.

That's it for another edition of your OT R/C place. How about you; do you have something to add for our enjoyment? You sure are welcome! ■

JETS OVER DELAND

(Continued from page 82)

fairly close in to the 800-foot-long line of spectators, slowly weaving back and forth. This was particularly effective with the turbine-powered F-18 because of the totally realistic sound of its large turbine jet engine. That's called showmanship and really helps our hobby in the eyes of the public. I can just hear many of them saying, "These planes certainly aren't toys!"

I would like to point out that over a three-day period, Bob Fiorenze was flying three large, complex, twin-engine, ducted-fan planes and had not a single engine failure. This is not quite a record because I saw Dennis Crooks do it with four, twin-engine, ducted-fan planes several years ago at the Southwest Ducted-Fan Fly-In. These two guys are in a class by themselves.

SHOWTIME

About noon on Saturday, time was set aside for a series of outstanding demo flights that alone were more than worth the price of admission for the large crowd of spectators ($3 for an entire family). Contest director Frank Anderson had seen to it that the area papers and TV stations had advertised this meet for weeks. His efforts paid off big time, especially on Saturday when the spectators were four deep behind the ropes for the complete 1,660-foot runway. And this in spite of low, thick clouds occasionally spitting light rain. Unfortunately, on Sunday, this great meet was rained out. But at least their drought was broken.

SPONSORS

Ace Hobbies (Daytona)	Hobby-Tec
Ace R/C (Mfg. & Dist.)	JDM Products
Aerospace Composite Products	Jet Pilots Organization
Bob's Hobby Center (Orlando)	J.I.L. Flight Training
Bob Parkinson Flying Models	Pacific Northwest Industries
Bob Violett Models Inc.	Quadrotech—Canada
Colonial Hobbies (Orlando)	Quality Hobbies Inc.
Cressline Models	*R/C Jet International* magazine
Custom Aircraft Covers	*R/C Modeler* magazine
Custom Cut	Robart Mfg.
Dan Vincent Computer Graphics	Telstar Video Productions Inc.
Davis Model Products	TCI Cable TV
Dry-Set Model Markings	TNR Technical Inc.
Fiorenze's Hobby Center Inc.	Top Gun Aircraft
Graves R/C Airplanes (Orlando)	Zap Gang

Besides a good barbecued chicken feed te on Friday afternoon at the field, there ere two off-field events. First, Bob iolett invited all the fan-fly participants a buffet supper on Thursday evening his new plant and then personally con-icted a complete tour of his plant—most teresting. The second event was a turbine mposium held on Saturday evening at e Holiday Inn. Turbines are here to stay; doubt about it.

Though billed as a "Jet-Together" and finitely not a contest, there were several ards and events scheduled. Since all-day

(Continued on page 118)

JETS OVER DELAND

(Continued from page 105)

rain was forecast for Sunday (100 percent accurate), the award ceremonies were held on Saturday afternoon. Fittingly, they were opened by Deland's mayor, David C. Rigsby.

With 162 pilots registered, this fan/turbine-fly was the largest ever held anywhere in the world. But the success of a meet always goes far beyond just numbers. Several factors made this "jet-fly" a truly memorable one: the many fliers and visitors from 13 countries; the variety and quality of the models; the three different turbine engine designs flown and, finally, a gathering of many of the world's best fan/turbine pilots.

So, heartiest congratulations and thanks are in order for contest director Frank Anderson, all his hard-working crew, the Golden Hawks R/C Club and, finally, to the many generous sponsors (see list).

One last word: I certainly picked the top jet fly to attend for observing, learning and having a great time.

**Addresses are listed alphabetically in the Index of Manufacturers (for page number, see contents).* ■

AIRWAVES

(Continued from page 9)

IN THE BEGINNING

I clearly remember my one and only visit to Van Cortland Park in New York City. I went with my dad and his friend Irving Gross to watch Irving fly his model airplane. It must have been 1954 (give or take a year or two). I remember being captivated by the experience; I developed a lifelong love for anything that flies. I started flying R/C last year. Irving Gross lived in the Bronx back then and later in Syosset, Long Island. He was a navigator for a commercial airline and is in his late 70s now. I'd like to get in contact with Mr. Gross. Thanks for any help.

EDWARD FERTIK
150 Prospect Park W., Brooklyn, NY 11215

Ed, for many older New England modelers, Van Cortland Park will stir fond memories of the early days of free-flight and R/C modeling. Because modelers have always been a rather close-knit group, perhaps there is a reader out there who can help you in your search for your modeling mentor. Good luck. GY

CLASSIFIEDS

RATES: non-commercial—25 cents per word. No charge for name and address (no commercial ads of any kind accepted at this rate); commercial— 50 cents per word (applies to retailers, manufacturers, etc.); count all initials, numbers, name and address, city, state, zip code and phone number. **All ads must be paid for in advance.**

To run your ad for more than one month, multiply your payment by the number of months you want it to run. Deadline: the 10th day of the month, 3 months in advance, e.g., *January 10 for the April issue.* We don't furnish box numbers, and it isn't our policy to send tear sheets. **SEND AD AND PAYMENT TO: CLASSIFIED ADS, Model Airplane News, 251 Danbury Rd., Wilton, CT 06897.**

R/C WORLD ORLANDO, FL, CONDO RENTAL: 2 bedroom, furnished. Available weekly or monthly. Low rates. 100-acre flying field with enclosed hangars. Close to Disney World and Epcot Center. For information, please call or write to R/C World, 1302 Stearman Ct., Orlando, FL 32825; (407) 380-6359.

WANTED: your old proportional radios; interested in pre-1980, American made; C&S, Deans, Klinetronics Spar and others. Older is better. Ron Gwara, 21 Circle Dr., Waverly, NY 14892; (607) 565-7486. [9/94]

WANTED: old engine parts, misc. junk before 1970. Wesley Pettinger, 1501 Banbury Ct., Richardson, TX 75082; (214) 669-4003. [7/94]

ANTIQUE IGNITION AND GLOW PARTS CATALOGUE: 100 pages–timers, needle valves, original cylinder heads, point sets, drive washers, stacks, spark plugs, plans. Engines: Atwoods, Baby Cyclones, McCoys, Hornets, others. $8 postpaid, U.S.; $20, foreign. Chris Rossbach, R.D. 1 Queensboro Manor, Box 390, Gloversville, NY 12078. [8/94]

HELICOPTER SCHOOL—five days of hands-on instruction with X-Cell helicopters and Futuba computer radios. Small classes tailored to your individual needs. Beginner to expert. Includes all meals and lodging. Over 350 satisfied students and 3,000 flights logged. Located on a 67-acre airport used exclusively for R/C training; owned and operated by Ernie Huber, five-time National Helicopter Champion and helicopter designer. Send for *free* information and class schedule *now!* R/C Flight Training Center, P.O. Box 727, Crescent City, FL 32112-0727, or call (800) 452-1677. Outside USA: (904) 698-4275, or fax (904) 698-4724. [9/94]

SALE—kits: wood, plastic; ignition engines; parts and mags (pre-1965). Specify needs. Send SASE and 60 cents for list. Leonard Roberts, 3819 Lydon Ln., Moosic, PA 18507; (717) 961-2357. [12/94]

CUSTOM KIT BUILDING. Will build most kits from trainers to ¼ scale; 20 years experience. Write for quotes: Midwest Model Factory, 280060 Highland Rd., Minatare, NE 69356. [8/94]

WANTED: built or partially built Ercoupes, Cessna 150, 152, 172, 182, Grumman American Tiger (AA5), American Yankee (AA1), or Mooney M-10 Cadet. Glen Mills, P.O. Box 3393, Mission Viejo, CA 92690; (714) 768-0585. [11/94]

PLANS ENLARGED. Scanning/plotting services; model designer's computer software; free information. Concept, P.O. Box 669E, Poway, CA 92074-0669; (619) 486-2464.

MAKE REAL DECALS with your computer and printer! Send $10 for starter kit and instructions to LABCO, 27563 Dover, Warren, MI 48093-4764. [11/94]

GIANT-SCALE PLANS by Hostetler. Send SASE to Wendell Hostetler's Plans, 1041 B Heatherwood, Orrville, OH 44667. [11/94]

ENGINES: IGNITION, GLOW, DIESEL—new, used, collectors, runners. Sell, trade, buy. Send $3 for huge list to Rob Eierman, 504 Las Posas, Ridgecrest, CA 93555; (619) 375-5537. [11/94]

ARE YOU TIRED OF PAYING $1.29 for six screws? For a *free* catalogue and price list of screws, nuts, locknuts, blind nuts and more, in sizes from 0-80 to ¼ inch, contact Micro Fasteners, 110 Hillcrest Rd., Flemington, NJ 08822; (800) 892-6917; fax (908) 788-2607. [11/94]

MODEL MOTORS WANTED—Most types, 1970 and earlier. Cash or trade. T. Crouss, 100 Smyrna, West Springfield, MA 01089. [9/94]

R/C SKYDIVING—illustrated catalogue: $1. R/C Skydivers, Box 662N, St. Croix Falls, WI 54024. [7/94]

BALL BEARINGS—now! Full-time bearing service. Bearings in stock to fit most model engines, steel, phenolic, or polymide. Installation available. UPS service; SASE for price list: Revmor, P.O. Box 548, Palm City, FL 34990; (407) 283-6831. [7/94]

ANTIQUE IGNITION engine parts: excellent reproductions, fuel tanks, points, timers, coils, needle valves, gaskets, etc. Champion spark plugs. Catalogue—$5 (intl. airmail—$7). Aero-Electric, 1301 W. Lafayette St., Sturgis, MI 49091. [8/94]

WANTED: ignition model engines 1930s to 1950s, especially Elf, Baby Cyclone, Brown Jr., Ohlsson Custom and Gold Seal. Also model racecars, any parts, spark plugs, etc.; Woody Bartelt, 1301 W. Lafayette St., Sturgis, MI 49091; (616) 665-9693, or (800) 982-5464. [8/94]

LOCKHEED P-38 LIGHTNING. If P-38s—R/C scale models or full size—are your *thing*, join the P-38 Model Organization International—a worldwide association for P-38 enthusiasts. For more information, send $1 to P-38 M.O.I. Medelbyvej 54 DK 2610 Rodovre, Copenhagen, Denmark.

SCALE DOCUMENTATION and resource guide. Larger, updated 1994 Edition. World's largest commercial aircraft collection. Over 5,000 different color FOTO-PAAKS and 25,000 three-view drawings; 152-page resource guide/catalogue—$6 (Canada—$7; foreign—$12). Bob Banka's Scale Model Research, 3114 Yukon Ave., Costa Mesa, CA 92626; (714) 979-8058. [8/94]

INTERNATIONAL AIRCRAFT RESEARCH: need documentation? Include name of aircraft for availability of documentation, with $3 for photo and three-view catalogue. 1447 Helm Ct., Mississauga, Ontario, Canada L5J 3G3. [9/94]

MAGAZINE BACK ISSUES—*Flying Aces, Model Airplane News, Air Trails,* 1930s and '40s. FM, RCM and more. Send SASE for list to Carolyn Gierke, 1276 Ransom Rd., Lancaster, NY 14086. [9/94]

NEW FIBERGLASS UH-60A helicopter fuselage for .60-size mechanics: $250; (203) 288-5719. [7/94]

PAYING $50 *each for toy metal outboard boat motors*—Mercury, Evinrude, Gale, Oliver, Scott, Johnson. Ship for immediate payment, or call (616) 941-2111; Richard Gronowski, 140 N. Garfield Ave., Traverse City, MI 49684. [8/94]

MODEL GRAPHICS/VINYL LETTERING—Introducing new 20-page instructional catalogue and model decorating guide. *Special offer:* any combination of 10, 2-inch letters or numbers, custom-cut and ready to install, with catalogue—$4.95. Graphics A.M.P. Inc., 42a Nancy St., W. Babylon, NY 11704; (516) 253-2702. [7/94]

SMOOSHIE BAILS OUT! Release a scale-like parachutist!—a real crowd pleaser and a lot of fun! For a brochure, send SASE to Hobby Hut Mfg., 2040 W. 21st. N., Ste. 77, Wichita, KS 67203-2107 (Dept MAN). [10/94]

GERMAN AIRCRAFT WW II—handbooks, service part lists, instruction manuals. List—$2. Udo E Hafner, Eugen-Bolz-Str. 15, D-71636 Ludwigsburg, Germany. [11/94]

KIT CUTTING—Will custom-cut any kit to your specifications. Your plans or mine—*guaranteed* quality like none other. Call or write: 43940 Yorktown, Canton, MI 48188; (313) 697-6804. [8/94]

HELP! I need the following toy metal outboard boat motors: *Oliver,* Gale Sovereign, Buccaneer, *Evinrude* Lark, Starflite, *Mercury* Mark 55,75,78,1000, *Scott-Atwater, Johnson* 40, 75, *Sea-Fury* 2-cylinder. Paying $75 to $100 each. Richard Gronowski, 140 N. Garfield Ave., Traverse City, MI 49684; (616) 941-2111. [8/94]

R/C PRODUCTS: CA Tip Extender—6 for $1 (2- and 4-inch). Discounted kits, balsa, ply, hardware, etc. Catalogue—$2. Shoreham Model Airplanes, P.O. Box 794, Shoreham, NY 11786. [8/94]

P-38 LIGHTNING—Columbia Model Works kit: 95-inch wingspan, SuperTigre 2500s, Robart retracts, Futaba radio. Everything new—never been flown. Will crate and ship—$2,800 (Lasalle, IL). (815) 223-6782. **Note: previously advertised with incorrect telephone number—call again.** [7/94]

WW I PLANS—Peanut to 100 inches. Send $2 for illustrated catalogue to Clark Smiley, 23 Riverbend Rd., Newmarket, NH 03857. [3/95]

CASH FOR ENGINES: ignition, glow, diesel—all types; any condition; sale list, too! Estates my specialty! Send SASE for list: Bob Bournstein, 2811 S. 165th Ave., Omaha, NE 68130; (402) 334-0122. [8/94]

ONE-INCH BELT SANDER. Build yours for less than $20. No special tools required. Send $7 to Crafty Creations, Box 222, Burlington, KS 66839. [8/94]

DORNIER DO26 PLANS—118-inch wingspan; other seaplanes. For information, send SASE with two postage stamps to Gene Falada, Sea-Clusion Aeronautics, 22W070 Byron, Addison, IL 60101. [7/94]

MAGAZINE BACK ISSUES—*Air Trails, Model Airplane News,* 1940s, 1950s. Send SASE for list to Gary Nachbar, 13822 White St., Springville, NY 14141. [7/94]

BOOKS! "Tailless Tale"—tailless aircraft for modelers; $38. "Structural Dimensioning of Radioguided Aeromodels"—building strong and light; $18. "On the Wing...the book"—tailless R/C sailplanes; $28. Orders or information: B2 Streamlines, Dept. A, P.O. Box 976, Olalla, WA 98359. [9/94]

HISTORIC REPLICAS: Flying Tigers, 94th Aero, Lafayette Escadrille Accessories, Pilot Sport Shirts, T-Shirts, Wings, Pins, Medals, Beer Steins, Scarves. Free gift with order; catalogue $1, *refundable. Company of Eagles, 875A Island Dr., Ste. 322N,* Alameda, CA 94502. [9/94]

DO YOU SPEAK MODEL AIRPLANE? Seventy years of aeromodeling history! All the heroes, contests, models! Paperback, 320 pages, $19.95 postpaid. Also: Old Buzzard's Soaring Book, $16.95. Dave Thornburg, 5 Monticello, Albuquerque, NM 87123; (505) 299-8749 for Visa/MC. [10/94]

FLY DAVE BROWN SIMULATOR. Use your transmitter. Works with Futaba, JR, Airtronics, Hitec. Uses standard joystick connection. For more info, contact Computer Designs, 8530 N. Montana Ave., Helena, MT 58601; (406) 458-9416. [9/94]

OLD MODEL MAGAZINES. SASE for list. Dave Bessel, P.O. Box 669, Poway, CA 92074.

NEW ZEALAND AERO PRODUCTS. Scale plans: Agwagon, Pawnee, Pawnee Brave, Airtruk/Skyfarmer, Fletcher FU-24, Aerobat, Hall's Springfield Bulldog, Typhoon, DC-3/C-47, Fairchild PT-19/Fleet PT-26 and more. Epoxy fiberglass parts, hardware packs, timber packs, color photo packs available. Free documentation with plans. Fiberglass kit sets: P-51D Mustang, PBY Catalina, Focke Wulf 190, Bushby Midget Mustang. Catalogue/price list: $5 (U.S.); Visa/MC. 34 Ward Parade, Stirling Point, Bluff, New Zealand. Phone/fax-032128192.

I BUY G.I. JOE. I fly R/C and collect G.I. Joe. If you have any to part with, call or write with description and price. Jeff Gilbert, 130 N. Vernon St., Princeton, IL 61356; (815) 875-4611. [8/94]

MOLD-MAKING/CASTING GUIDEBOOKS. Complete techniques and sources for rubbers, plastics, resins, metals and more. Further information: Castech-A7, Box 16586, Memphis, TN 38186-0586. [9/94]

ENGINES FOR SALE: new, used, early and late glows. Some with carbs and mufflers. SASE for list. Joel Balsam, 4 Pickwick Hill Dr., Huntington Station, New York, NY 11746-1241. [9/94]

TRADE: GHQ spark-ignition, model-airplane motor for toy, metal, outboard-boat motors: Oliver, Gale, Evinrude, Scott, Mercury. Also *buying above motors.* Richard Gronowski, 140 N. Garfield Ave., Traverse City, MI 49684; (616) 941-2111. [7/94]

ULTRALIGHT AIRCRAFT. New publication has plenty of information, pictures and stories on this exciting flying sport. Buy, sell, trade and kit-built aircraft. You can learn to fly the real thing. Fixed wing, powered parachutes, rotor, balloons and blimps. Sample issue $3. Annual subscription $36. *Introductory offer of only $24.* Ultraflight Magazine, 12545 70th St. N., Largo, FL 34643-3025. [7/94]

AEROMODELERS—build this engine test-stand bench. It will be a big help in finding a place to test and break in your engines. Plans $10; send to: Stephen Pustay, P.O. Box 329, McClellandtown, PA 15458. [7/94]

R/C SWAPMEET IN YOUR LIVING ROOM! Nationwide buy/sell/trade newsletter with fast circulation. Free sample copy. R/C Trader, P.O. Box 145, Big Lake, MN 55309; (612) 295-7521. [8/94]

HOBBY SHOP DIRECTORY

Retailers: Make your business grow with new traffic! Now you can advertise your hobby shop in the ***Model Airplane News*** **Hobby Shop Directory**. The entry will be published monthly and will be listed according to city and state. You have 3 or 4 lines, approximately 20 words, in which to deliver your sales message, plus space for your store's name, address and telephone number.

HOBBY SHOP DIRECTORY SPACE RATE
• $179 per year • $97 for six months • $48.50 for three months—ALL PAYABLE IN ADVANCE! Space reservations must be received by the 10th of the third month preceding publication (for example, January 10th for the April issue).

LATIN AMERICA
Belo Horizonte-Brasil
Completa linha de aeromodelos, carros, barcose helicopteros radio controlados, plasti-modelismo, componentes e servicos. Importacão direta.

HOBBY 'N WOOD MODELISMO LTDA.
Av. Silviano Brandao 2100 Tel: (031) 463-9944
Fax: 55-031-4615501
[9/94]

OHIO-Findlay
Findlay's local R/C dealer—planes, cars, boats. We specialize in R/C. Large selection of kits, accessories and parts. We're authorized Sig and Dremel dealers. We also sell model-rocket and model-railroad supplies. NEHO gauge. Tue./Thu. 1-9; Mon./Wed./Fri. 10-9; Sat. 10-5.

JINX MODEL SUPPLIES
721 Rockwell Ave. (419) 422-5589
[9/94]

Send sales message and payment to:
Model Airplane News,
Hobby Shop Directory,
251 Danbury Rd., Wilton, CT 06897.
For more information, call toll-free (800) 243-6685 and ask for Arlene Melko.

PRODUCT NEWS

YELLOW AIRCRAFT

F-4E Phantom II

This scale ducted-fan kit features a recessed, molded-fiberglass access hatch and comes with a clear canopy and a separate fiberglass canopy frame. The rudder is separate from the vertical fin and includes custom-built, heavy-duty, rudder torque rods. Specifications: length—68 inches; wingspan—43½ inches; weight—9 to 11 pounds; recommended power—at least a .77 ducted-fan engine with any 5¼-inch tractor-type fan unit.

Price—$365.

Yellow Aircraft and Hobby Supplies Ltd., 203 Massachusetts Ave., Lexington, MA 02173; (617) 674-2222.

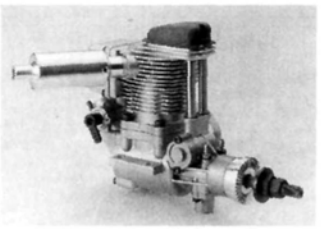
BALSA USA

USA Gold CA

To ensure premium quality, maximum bonding and a long shelf life, USA Gold CA adhesive is distilled three times. It bonds balsa, spruce, plywood, fiberglass and plastics. It's great for repairs, and it doesn't run. Compared with other brands, USA Gold CA has a tensile strength that's 25 to 50 percent stronger and a shock strength that's five times greater.

Prices—$4.95/1-ounce bottle (thick or thin), $8.95/2-ounce bottle (thick or thin), $7.75/CA gel tube.

Balsa USA, P.O. Box 164, Marinette, WI 54143; (906) 863-6421.



FUTABA

YS 91AC Engine

The power and sophistication of the YS Futaba 120AC is now available in the popular .91 size. All the features of the 120, such as supercharging, fuel injection and 4-stroke design, have been engineered into the YS Futaba 91AC. The 91AC has a special air chamber, crankcase pressurization and a double throttle valve that acts like a tuned intake manifold to increase the fuel/air charge. The engine is designed for sport and competition flying and can be used in most .60 2-stroke and .91 4-stroke models. Specifications: bore—27.7mm; stroke—24.8mm; weight (with muffler)—28 ounces; rpm—2,000 to 12,500.

Part no.—YS0081; **price**—$499.95.

Futaba Corp. of America, 4 Studebaker, Irvine, CA 92718; (714) 455-9888.

ELECTRODYNAMICS INC.

EDR-201 "Eye-Test" Current Probe

Stalled servos? Find them fast with the EDR-201 "Eye-Test" Current Probe. It can be plugged between your battery and your receiver, or between your receiver and individual servos. It uses an ammeter (such as the ElectroDynamics DM100 Digital Multimeter) to measure current drain. Two versions are available—for Futaba/JR and Airtronics systems.

Price—$15.95.

ElectroDynamics Inc., 9557 Crosley, Redford, MI 48239; (313) 534-6514.

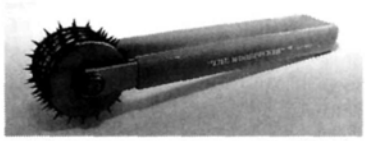
MAR' WEST MFG.

Hot Box

The Hot Box is made of a strong, molded, fuelproof material; it has a lock, a lighted master power switch, a battery-charger receptacle, a deluxe power panel, a built-in fuel pump and quick-connect fittings. There's plenty of room for a transmitter and for storage. The battery compartment holds two 12V gell-cell batteries. It's a perfect height for working on your plane. Dimensions—20¼x15½x13 inches.

Product no.—HB-1000; **price**—$169.95 (plus $9.95 S&H), introductory price—$139.95.

Mar' West Mfg. and Dist. Co., P.O. Box 1206, Folsom, CA 95630; (916) 961-4703; (800) HOT-BOX2 (for orders only); fax (916) 983-1923.



UNIQUE MODEL PRODUCTS

The Woodpecker™

This unique covering tool (patent pending) enables you to aerate solid ply and balsa surfaces with thousands of microholes in just minutes; this allows trapped gases created by heating your covering material to escape—no more bubbles or sagging. The Woodpecker™ works on fabric, film and all iron-on coverings.

Price—$18.95 (plus $2.60 S&H; California residents, please add 7.75-percent sales tax).

Unique Model Products, P.O. Box 2229, Lake Arrowhead, CA 92352-2229; (909) 336-5602; (800) 336-5602 (for orders only).

PRODUCT NEWS

JAMARA

Focke Wulf 190 D

This Luftwaffe FW 190 D fighter kit includes an engine mount, decals and obechi-sheeted foam wings. It's available in ARF and kit form for either glow or electric power. Specifications: wingspan—43.6 inches; length—38.8 inches; engine—.15 to .25 2-stroke; radio—3- or 4-channel.

Kit nos.—00 5520 (glow ARF), 01 5580 (glow kit); **prices**—$117.30, $85.

Jamara; distributed exclusively by Alpha USA, 55 Leveroni Ct., Novato, CA 94949; (800) 685-8290 or (415) 884-3030; fax (415) 884-3033.

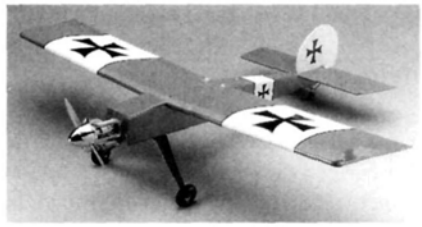
SKYSTAR

Kitfox Classic IV

Here's a *full-size* project! The Kitfox Classic IV can support a range of standard powerplants, from the 2-stroke Rotax 503 and 582 to the 4-stroke Rotax 912. It's available with tundra tires, amphibious or straight floats, or skis. The complete kit includes a Rotax 503, an engine component kit and all the necessary hardware. Specifications: wingspan—32 feet; wing area—132 square feet; weight, depending on engine—560 pounds (empty), 1,200 pounds (gross; with Rotax 582).

Prices—$10,995, $14,995 (complete kit).

Skystar Aircraft Corp., 100 N. Kings Rd., Nampa, ID 83687; (208) 466-1711; fax (208) 466-8703.



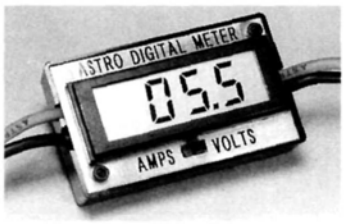
MODEL TECH

Joss Stik BHP™

This easy-to-fly, sport/aileron trainer comes built, sanded and ready to finish. It has a thick, symmetrical airfoil with a broad speed range; land it slowly and perform aerobatic maneuvers. It has foam-core wings, fiberglass main gear and basic hardware. Specifications: wingspan—67½ inches; wing area—877 square inches; weight—8 to 9 pounds; engine—.60 to 1.08 2-stroke, 1.20 to 1.60 4-stroke; radio—4-channel.

Kit no.—123770; **price**—$205.

Model Tech; distributed by Global Hobby Distributors, 10725 Ellis Ave., Fountain Valley, CA 92728-8610; (714) 963-0133.



ASTROFLIGHT

Digital Volt/Amp Meter

Testing and tuning your motor for maximum performance have never been easier. Astro's Digital Volt/Amp Meter can be hooked in line between your motor and your battery or power supply. At the flick of a switch, it tells you your pack's voltage or your motor's amp draw. This meter features two Zero-Loss connectors and 13-gauge wiring and is rated up to 100 volts and 60 amps.

Price—$69.95.

AstroFlight Inc., 13311 Beach Ave., Marina Del Rey, CA 90292; (310) 821-6242.

M&E ELECTRONICS

Ni-Cd Charger

This is the only adjustable, 12V, Mosfet charger that can quickly charge your 4- or 5-cell receiver packs and 8- or 9-cell transmitter packs to 100-percent capacity. Independently adjustable charge currents for the receiver and transmitter allow you to charge Ni-Cds from 0 to more than 1400mAh. With automatic voltage sensing, the fast charge will terminate and go to a standby mode; this reduces current drain on the power source.

Price—$59.95.

M&E Electronics, 354 Manchester St., Ste. 224, Manchester, NH 03103; (603) 644-3262.

WINDSOR PROPELLER

Scimitar Propeller

Windsor Propeller announces the release of its Scimitar series of propellers. With a scimitar shape and thin, under-cambered blades and swept-back narrow tips, the updated design delivers greater thrust at lower rpm and, consequently, lower decibels. The charcoal-gray, glass-filled nylon propellers are available in sizes from 8x5 to 12x6.

Price—from $1.59 to $3.29.

Windsor Propeller Co., 3219 Monier Cir., Rancho Cordova, CA 95742; (916) 631-8385.

Descriptions of products appearing in these pages were derived from press releases by the manufacturers and/or their advertising agencies. The information given here does not constitute endorsement by **Model Airplane News**, nor guarantee product performance. When writing to the manufacturer about any product described here, be sure to mention that you read about it in **Model Airplane News**.

Manufacturers! To have your products featured here, address the press releases to **Model Airplane News,** attention: Julie Soriano.

NAME THAT PLANE

CAN YOU IDENTIFY THIS AIRCRAFT?

If you can, send your answer to *Model Airplane News*, **Name That Plane Contest** (state issue in which plane appeared), 251 Danbury Rd., Wilton, CT 06897.

PHOTO COURTESY OF SCALE MODEL RESEARCH

CONGRATULATIONS to Frank W. Beatty for correctly identifying the Vultee V-11GB attack bomber (export version) shown in our April '94 issue. Mr. Beatty noted that this very photo, taken by Robert C. Morrison, was published in our February '38 issue (see "Frontiers of Aviation," page 11, and the three-view, page 12). We're impressed! The ship shown was an attack/bomber test plane and seems to be an early example; approximately 40 of these aircraft were sent to Turkey in 1938 and '39. The plane was equipped to carry two bombs under its belly, and it also had several barographs for testing the plane in dives. The V-11GB carried a crew of three, including a pilot and a rear gunner (in a reversible seat) in the cockpit and a bombadier, who was positioned below and behind the rear gunner. The bombadier could lean forward and release bombs, or reverse position and lower a rearward-looking, retractable gun pit. The powerplant, a Wright Cyclone GR-1820-G105A radial rated at 900hp at 6,500 feet, turned a three-blade, constant-speed propeller. Attack and bomber versions of the plane were built. ■

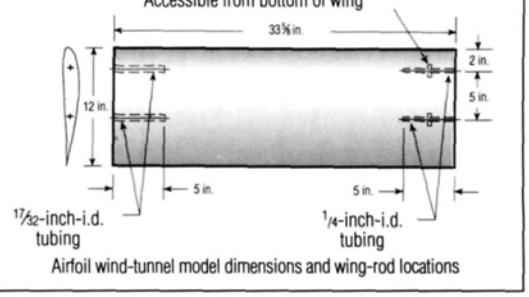
The winner will be drawn four weeks following publication from correct answers received (on a postcard delivered by U.S. Mail), and will receive a free one-year subscription to **Model Airplane News**. If already a subscriber, the winner will receive a free one-year extension of his subscription.

(Continued from page 7)

$200 per airfoil tested. That's a deal! And the hobby will never be the same!

To date, monetary contributions have come from 21 individuals, three flying clubs and the National Free Flight Association (who donated more money than anyone other than the University of Illinois). But it isn't enough. I have spoken with Bob Underwood, executive director of the AMA (who had been contacted separately), and he has agreed to put this program before the executive council at the next meeting. The AMA has funded sound studies and other worthy projects, and I believe they should accord this test program equal priority. Just think: if only 240 modelers donate $50 each, a robust testing program will be assured for the next 12 months. If 600 readers donate only $20 each, we will have the same result. *If no one donates additional money, the program is likely to expire later this year and, with it, the chance to improve model flight performance for the foreseeable future.*

AIRFOIL MODEL FOR WIND-TUNNEL TESTING



Airfoil wind-tunnel model dimensions and wing-rod locations

I have just made out a personal check for $50 payable to "University of Illinois, AAE Dept." As requested by Michael, I have also written on that check "Selig-Wing Tunnel Testing/AAE Unrestricted Funds." Incidentally, *Model Airplane News* and I have no connection with this project whatsoever, but I could not sit back and do nothing. What are you going to do? In my opinion, we can't let this one pass us by.

BUILDING WINGS

But wait, there's one more important point. Michael also needs help in preparing airfoils. Over 50 builders have offered their services (including Michael Lachowski, Walt Good, Jef Raskin, Mark Allen and Bob Champine—a very well-known former NACA test pilot and X-1 pilot—among many other notables). Wind-tunnel wing models should be 33⅝ inches in span with a 12-inch chord and can be built up or foam-core. To ensure a uniform contour, the built-up models must be fully sheeted. For the foam-core models, Michael can supply you with six, 12-inch-chord airfoil plots. Surface finish can be either fiberglass or MonoKote, although if support materializes, there are plans for tests using rougher surfaces. If you're interested in building wind-tunnel models for these tests, please write, call, fax, or e-mail to the graduate student in charge: James J. Guglielmo, Coordinator, Dept. of Aeronautical and Astronautical Eng., University of Illinois at Urbana—Champaign, 306 Talbot Laboratory, 104 S. Wright St., Urbana, IL 61801-2935. Work phone: (217) 244-0684; home answering machine: (217) 367-1960; fax: (217) 244-0720. Internet address: jjgug@uxh.cso.uiuc.edu.

If you wish to make a contribution or to help out in any other way, or if you have questions on the testing program, contact Michael Selig, Asst. Prof., University of Illinois at Urbana at the address already given.

If you have any comments on this project or my pitch for your help, I can be reached at *Model Airplane News*, 251 Danbury Rd., Wilton, CT 06897; fax: (203) 762-9803; Internet: toma@airage.com. ■

INDEX OF MANUFACTURERS

Ace R/C Inc., *116 W. 19th St., Box 511C, Higginsville, MO 64037.*

Aeroloft Designs, *2940 W. Gregg Dr., Chandler, AZ 85224.*

Aero-naut, *Postfach 11 45, D-72701 Reutlingen, Germany.*

Airdrome Plans Service, *P.O. Box 1425, FDR Stn., New York, NY 10150; (212) 421-1440.*

Airtronics Inc., *11 Autry, Irvine, CA 92718.*

APC Props; *distributed by Landing Products, P.O. Box 938, Knights Landing, CA 95645.*

AstroFlight Inc., *13311 Beach Ave., Marina Del Rey, CA 90292.*

Balsa USA, *P.O. Box 164, Marinette, WI 54143.*

Bob Smith Industries, *8060 Morro Rd., Atascadero, CA 93422.*

Bob Violett Models (BVM), *170 State Rd. 419, Winter Springs, FL 32708.*

Byron Originals, *P.O. Box 279, Ida Grove, IA 51445.*

Carl Goldberg Models, *4734 W. Chicago Ave., Chicago, IL 60651.*

Coverite, *420 Babylon Rd., Horsham, PA 19044.*

Dave Platt Models, *1306 Haver N.W., Palm Bay, FL 32907; (407) 724-2144.*

Du-Bro Products, *480 Bonner Rd., Wauconda, IL 60084.*

Enya; *distributed by Altech Marketing, P.O. Box 391, Edison, NJ 08818-0391.*

EZ; *distributed by Hobby Shack, 18480 Bandilier Cir., Fountain Valley, CA 92728.*

Fox Mfg. Co., *5305 Towson Ave., Ft. Smith, AR 72901.*

Frank Tiano Enterprises, *15300 Estancia Ln., W. Palm Beach, FL 33414; (407) 795-6600.*

Futaba Corp. of America, *4 tudebaker, Irvine, CA 718.*

at Planes Model Distribu- *, P.O. Box 9021, Cham- n, IL 61826-9021; (217) 300.*

Hirobo; *distributed by Altech Marketing, P.O. Box 391, Edison, NJ 08818-0391; (908) 248-8738.*

Hobbico/Great Planes Model Distributors *(see address above).*

Hobby Lobby Intl., *5614 Franklin Pike Cir., Brentwood, TN 37027.*

Hobbypoxy Products, *div. of Pettit Paint Co. Inc., 36 Pine St., Rockaway, NJ 07866.*

Horizon Hobby Distributors, *4105 Fieldstone Rd., Champaign, IL 61821; (217) 355-0022.*

Jeff Seymour; *contact Tom Sierocuk (business and product-development manager), SWB Turbines, 8336 White Hill Ln., Westchester, OH 45069.*

Jet Model Products, *211 N. Mullen Rd., Belton, MO 64012; (816) 331-0356.*

JR Remote Control; *distributed by Horizon Hobby Distributors (see address above); (217) 355-9511.*

K&B Mfg. Inc., *2100 College Dr., Lake Havasu City, AZ 86403.*

Lone Star Models, *1623 57th St., Lubbock, TX 79412; (806) 745-6394.*

Master Airscrew; *distributed by Windsor Propeller Co., 3219 Monier Cir., Rancho Cordova, CA 95742.*

Model Electronics Co., *6500 Sixth Ave. N.W., Seattle, WA 98117; (206) 782-7458.*

MonoKote; *distributed by Great Planes Model Distributors (see address above).*

Normark, *1710 E. 78th St., Minneapolis, MN 55423.*

Oracover; *distributed by Hobby Lobby Intl. (see address above).*

O.S.; *distributed by Great Planes Model Distributors (see address above).*

Paasche Airbrush Co., *7440 W. Lawrence Ave., Harwood Heights, IL 60656-3497.*

Pacer Technology, *9420 Santa Anita Ave., Rancho Cucamonga, CA 91730.*

Pica Enterprises Inc., *2657 N.E. 188th St., Miami, FL 33180.*

Robbe Model Sport, *170 Township Line Rd., Belle Mead, NJ 08502.*

Royal Products Corp., *790 W. Tennessee Ave., Denver, CO 80223; (303) 778-7781.*

Saito; *distributed by Horizon Hobby Distributors (see address above).*

Scale Model Research, *3114 Yukon Ave., Costa Mesa, CA 92626.*

Sermos R/C Snap Connectors, *Cedar Corners Stn., Box 16787, Stamford, CT 06905.*

Sig Mfg. Co., *401 S. Front St., Montezuma, IA 50171.*

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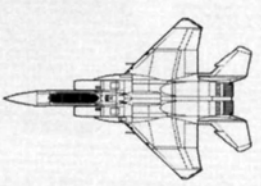

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